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ABSTRACT

A science and engineering fair is a competition based on the quality of projects done by students, the results of which are reported through exhibits and oral presentations at the fair. Fairs operate on a step basis. Students who win in small fairs such as a local fair, move to a city fair, then to a regional fair, and may be chosen to represent that fair in the International Science and Engineering Fair (ISEF). The finalists whose project abstracts are reported in this book won the honor of presenting their projects at the 35th ISEF in Columbus, Ohio, in May, 1983 as the result of being chosen the best in 314 affiliated fairs. Abstracts are organized by project categories. These 12 groups are described and include: behavioral and social sciences; biochemistry; botany; chemistry; earth and space sciences; engineering; environmental sciences; mathematics and computers; medicine and health; microbiology; physics; and zoology. An index is also included of all the finalists. (ML)

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ABSTRACTS

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ABSTRACTS

35th International Science and Engineering Fair

Abstracts of the Finalists

of the

International Science and Engineering Fair

held in

Columbus, Ohio

May 8-13, 1984

SCIENCE SERVICE
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PREFACE

A science and engineering fair is a competition based on the quality of projects done by students, the results of which are reported through exhibits and oral presentations at the fair.

The purpose of fairs is threefold: to stimulate in young people an active interest in science and engineering; to provide an educational experience through being exposed to the judges and to the public; and to give public recognition to talented students for the work they have done.

Fairs range in scope from the local level, which may involve one class, or one district, to ones which may involve a large city, a county, a state, or even a nation. While there are no exact figures, it is estimated that over one million student projects are undertaken each year in the United States, and that there are fairs in more than twenty other different countries.

Science and engineering fairs operate on a step basis, with students who have won in small fairs participating in large fairs as representatives of the fairs in which they have previously won. Thus, an individual might participate in a local fair, move to a city fair, then to a regional fair, and be chosen there to represent that fair in the International Science and Engineering Fair.

The finalists whose project abstracts are reported in this book won the honor of presenting their projects at the 35th ISEF in Columbus, Ohio in May 1984 as the result of being chosen the best in 314 affiliated fairs.

Science Service, the nonprofit institution devoted to the public understanding of science, which conducts the International Science and Engineering Fair, pays tribute to these finalists, to their teachers, and to the thousands of individuals and organizations who made possible the presence of these ISEF finalists in Albuquerque.

We wish to thank the General Motors Foundation for the funds which supported the printing of this book.

CONTENTS

Behavioral and Social Sciences 1

Biochemistry 20

Botany 41

Chemistry 65

Earth and Space Sciences 80

Engineering 94

Environmental Sciences 130

Mathematics and Computers 154

Medicine and Health 176

Microbiology 210

Physics 228

Zoology 249

ISEF Project Categories 275

Index of Finalists 279

BEHAVIORAL AND SOCIAL SCIENCES

#LEARNING AND EXTINCTION IN "CARASSIUS AURATUS"

WEISS DOUGLAS L.P., CITRUS HIGH SCHOOL
INVERNESS, FL. 32650
1560 S. HILLOCK TERRACE,
INVERNESS, FL. 32650

This project tests the effects of partial reinforcement on resistance to extinction in "Carassius auratus" (goldfish). It has been conclusively proven that in rats there is an inverse relation between resistance to extinction and consistency of reward: however, in analagous experiments with goldfish, PRE is not always apparent. The experimental design for this project sets up optimal conditions for the appearance of PRE: equated trials, large reward, low effortfulness (requiring only one bar press), massed trials, random reinforcement feeding schedule for partial group, and an instrumental situation. The hypothesis is "Carassius auratus" will exhibit more resistance to extinction after partial than after consistent reinforcement.

Subjects were ten experimentally naive "Carassius auratus" measuring 4-5" from a local store housed in two, ten-gallon tanks with individualized compartments. Habituation time was seven days. The experiment consists of lowering a target into the subject's compartment with a system for detecting contacts and an automatic pellet-feeder operated by the detecting system. In the first phase of the experiment, subjects were trained to hit a liver-baited target for seven daily sessions, followed by three daily sessions with an unbaited target. Subjects were then assigned randomly to either partial reinforcement (50% of the trials) or consistent reinforcement (100% of the trials) group. To equate total food consumption, supplemental post session feeding for the partial subjects was given. After fourteen days, an extinction session followed in which there was no reinforcement given to either group, and the number of responses in twenty minutes was measured. The results of the experiment indicated significance at the .05 level.

#Honorable Mention - American Psychological Association
Honorable Mention - United States Air Force

CHARACTERISTIC ANALYSIS OF OVERT AND NESCIENT CRIMINAL PSYCHOLOGY OF A RURAL POACHER

Thompson, Susanne, Clearwater High School, Piedmont, MO 63957
Rural Route 1, Box 42, Piedmont, MO 63957

The intent of this research is to collect data to determine if poaching is an overt act (having full knowledge of game laws; presence of criminal motive) or a nescient act (ignorance of game laws; presence of criminal behavior). In addition, the overt act of the poacher will be researched thoroughly to determine why the illegal act is being committed.

A survey of local high school and industry was utilized as a research tool to determine characteristic overt and nescient criminal acts. The types of criminal acts were contrasted to the different classification of poaching as related to overt action. Such actions reflected profit, fun, food, gift, and land harvest attitudes.

The results of the survey indicated that ninety-six percent of poaching activity was overt action. The deliberate assault on game reflects a serious lack of respect and understanding of Conservation Management practices and Missouri Ecology. The awareness of overt actions were reinforced by the excuse of food need and sport. The psychology of participants in illegal game activity reflected an association of family tradition as moral excuse to harvest game out of season. The association of student attitude was a reflection of adult attitude within the same ecology.

A STUDY OF TWO PROTOGYNOUS HERMAPHRODITIC FISH

Robinett, Chris E., Franklin H.S., Franklin, NE 68939
R.R. 1 Box 90, Riverton, NE 68972

The general intention of this research is to determine if a fish can change sex or at least its external morphological sexual appearance. Both salt water and fresh water fish will be used in this research. Based upon my literature search of other scientists' work, I feel that the largest female Xiphophorus hellerii can be induced to reverse her sex by the removal of the male. Through extensive literature searches I found that work of this type has never been done with the Thalassoma bifasciatum. I hypothesize that one can induce the largest female to reverse her sex by the removal of the male.

First, the salt water tanks must be assembled. Then a balance has to be reached in the tanks. After 4 to 5 weeks of operation with just the invertabrates, you must add the experimental fish (Thalassoma bifasciatum). Then you must place 3 yellow phase fish with 1 blue phase in each division of the tank. On the 7th day remove the male. Record the color change and see how many days it took to change.

First, the fresh water tanks must be assembled. Then you must place 4 females (Xiphophorus hellerii) with 1 male in each division of the tank. On the 7th day remove the male. Record the coloration change and see how many days it took to change.

I have just started the research on the Thalassoma bifasciatum and there have been no results obtained. Therefore, I can not draw a conclusion on this part of the research. Results of the research on the Xiphophorus hellerii show that a female can be induced to change her sex or at least her external morphological sexual appearance. The results show that the Xiphophorus hellerii is a protogynous hermaphroditic fish.

#Third Award - General Motors ISEF

#PRIMARY COLORS: DO THEY INFLUENCE AN IMPROVED VISUAL MEMORY?

Higdon, Joni R., Oologah H.S., Oologah, OK 74053
Rt. 5 Canyon Oaks 1-1, Claremore, OK 74017

The stimulation of visual memory retention through the use of primary and secondary colors was investigated in three types of reading students-those learning to read, those with reading disabilities, and those improving already acquired skills. An improved visual memory will benefit reading students because reading involves the recognition of printed symbols. These symbols serve as stimuli for the recall of meanings built up through a reader's past experience. It was the purpose of this phase of testing to determine if colors stimulate an improved visual memory in students strengthening previously acquired skills; and if so, which colors are best.

Fifty students of varied reading abilities in grades 9-12 participated in testing. Five standardized reading lessons, each consisting of a reading passage and comprehension questions, were selected as test material. Each lesson was copied onto one of five colors of paper. The students were instructed to read the passage printed on the front of the page and then answer the questions on the back of the page. The same procedure was repeated until each student had completed all five lessons, each on a different color of paper.

Results indicated that green encouraged best visual memory retention in these students. The lessons printed on white paper showed the next best response. Therefore, it was concluded that green is the best color to print reading materials on to improve visual memory.

#Fourth Award - General Motors ISEF

#MEMORY: CAN IT BE ENHANCED BY SUPPLEMENTARY SENSORY AIDS

Swarthout, Brenda L., Hildreth High School, Hildreth, Ne. 68947
R.R#1, Hildreth, Ne. 68947

This experimental project was constructed to determine the effects of rhymes, music, and color on a student's ability to learn. It would validate whether auditory and visual cues improve the pupil's ability to remember and recall knowledge.

Thirty-nine early elementary children from surrounding schools were divided into two equal ability groups according to their reading level. The two groups were then separated and not allowed to watch the other participants throughout this study. The material to the control group was presented strictly as facts. Rhyme, music, and color were incorporated with group two's lessons. Each category was tested separately and independently from each other. After an equal time allotment, each group was tested to determine the number of questions they answered correctly.

This study showed that group two did on the average 54.99% better than the control on the tests presented with rhyme, 25.15% better on the tests incorporating music, and an average 62.67% better on the tests in which they used markers of their favorite colors to complete the tasks. Over-all, the group learning with materials presented using rhyme, music, and color did an average of 47.60% better than the control.

Therefore, this data supported the hypothesis that rhyme, music, and especially color, amplify children's memorization skills.

#First Award - American Medical Association
First Award - General Motors Corporation
Second Award - General Motors ISEF
Third Award - American Optometrical Association and Auxiliary to the American Optometrical Association
Alternate to Scholarship - Ohio State University

THE DISTINCTIONS OF RETENTION IN SHORT-TERM MEMORY

Nancy Moore
424 North First Street
La Crescent, Minnesota 55947
La Crescent High School
La Crescent, Minnesota 55947

The phenomena of man's forgetting has been studied for centuries; however, no firm conclusion has since been derived from the research. Incorporating one of the theories proposed in Dr. Allan Baddeley's book, The Psychology of Memory, a computer program was designed to test one's memory.

The Interference theory is broken down into two types: Proactive Inhibition, interference of earlier learning with the retention of later learning, and Retroactive Inhibition, interference of subsequent learning on the retention of material already learned.

Herman Ebbinghaus, a German experimental psychologist, conducted an experiment whereby he himself would memorize a list of up to seven numbers. Mastering this list, Ebbinghaus found that when he increased the list to eight numbers, he would become confused and faulty in retaining the list. Therefore, he concluded that short-term memory has a limited capacity. Using this finding as a basis, retroactive inhibition was selected as memory's primary limiting factor.

The program was divided into two sub-tests, the first consisting of two relevant paragraphs. After reading these, the student was tested. The main purpose of this was to familiarize the subject with testing procedures. Afterwards, the second part, devised of irrelevant paragraphs began. After reading the material, the subject was again tested. The paragraphs were also reversed; however, results showed that their sequence had no effect on one's retention. Hence, results concluded that retroactive inhibition was the dominate factor which localized retention.

#EXPERIMENTAL ARCHAEOLOGY: LITHIC TOOL MANUFACTURE, UTILIZATION AND EDGEWEAR ANALYSIS

Ogburn, Meredith A., Monte Vista High School, Monte Vista, CO 81144
317 First Avenue, Monte Vista, CO 81144

When an artifact such as a projectile point is uncovered, questions that often arise are: How did man create such an implement? What was its purpose? This project was an attempt to answer these questions using two methods of investigation. The first method studied the various techniques involved in lithic tool manufacture through ethnological and archaeological view points. In this research, a lithic hand ax, knife and scraper were manufactured from Burlington chert. Photos were taken of particular edges of the tools. The lithic tools were then used to chop, saw, and scrape various floral and faunal material, including Aspen wood, antler, a bison mandible and elk hide. During the procedure, an obsidian flake was added to the collection of lithic tools. Following utilization, photos were again taken of the tools' edge patterns.

The study was then carried a step further. Small lithic chips were removed from the worn edges of the tools. These chips were viewed beneath a scanning electron microscope to examine edgewear patterns. It was hypothesized that edgewear patterns could indicate if a tool had once been utilized, as well as determine a particular function.

Results were minimal due to various problems in the procedure. However, this study provides a basis from which analysis of lithic tools will be continued.

#Second Award - General Motors ISEF

#SEPARATE AND CONCOMITANT EFFECTS OF CAFFEINE AND ASPIRIN ON LAB MICE

Killeen, Elizabeth, John Adams H.S., South Bend, IN 46615
304 S. Twyckenham Drive, South Bend, IN 46615

Researcher, Claudio Castellano, has cited conflicting behavioral results with caffeine; this stimulant is found in coffee, tea, colas, chocolate, and many pharmaceuticals. Castellano also said that the effects of caffeine depend on the type of test being performed. In addition, Castellano tested the theory that caffeine enhances the consolidation processes that convert a short-term-memory to long-term-memory.

While behavioral research with aspirin appears to be limited, aspirin tends to act as a depressant on activity. It is also the most common pain reliever, and many over the counter medicines contain both aspirin and caffeine.

In order to test the effects of both drugs, four groups of mice (36-52 wks) were used: a control, an aspirin group, a caffeine group, and an aspirin-caffeine group. Intro- and inter-group aggression tests rotarod tests, learning, memory, and nesting pattern, were then performed. Based on the results of these tests with mid le-aged mice, the same tests were run with young mice. The drugs were administered ad libitum resulting in approved intakes based on body mass.

This research found that caffeine does enhance memory and also raises aggression levels. It also found that young mice have a decreased tolerance for caffeine-contrary to the original hypothesis that young mice would have an increased tolerance. Conflicting results appeared in both the aspirin and the aspirin-caffeine groups. There appeared to be individual differences in these two groups. Concomitant effects of caffeine and aspirin appeared in certain tests.

#Fourth Award - General Motors ISEF

#NEURAL SUBSTRATES OF VISION AND THE EVOLUTION OF THE ALPHABET

Dworkin, Jonathan E., Hershey H.S., Hershey, PA 17033
435 Leearden Road, Hershey, PA 17033

There are, at present, two models of visual form perception for which there exists substantial neuro-physiological evidence. The ability of a computer implementation of a model of human form perception to mimic the pattern of human alphabetic letter discrimination may reflect its validity. Blough (1982) has demonstrated that pigeons and humans similarly discriminate between letters of the alphabet. This fact indicates that the process is probably neuro-physiologically primitive. It is hypothesized that the behavior of the neural substrates of vision has been the primary influence on the development of shape of individual letters within the alphabet, rather than the more widely considered influences of cultural or physical limitations. Consequently, the alphabet has come to incorporate an extremely wide range of form perceptual problems which the visual system is called upon to solve and, therefore is a set of stimuli which will test the widest range of functions of a computer simulation of a model of form perception. Simulations of both models were programed in Fortran. Letters were digitized and then operated on by the algorithms of the simulations. It was found that within the confines of one of the simulations, a specific parameter appeared to have a similar effect over several letters. This apparent continuity is a unique observation with respect to that model and thus may represent a finding of major importance.

#First Award - American Optometrical Association and Auxiliary to the American Optometrical Association
First Award - General Motors Corporation
Second Award - United States Air Force
Third Award - American Psychological Association
Third Award - General Motors ISEF

A MATHEMATICAL MODEL OF RIOT CONDITIONS AND RESULTS

Rodriguez, Quentin, Harlingen H.S., Harlingen, TX 78550;
1016 E. Austin, Harlingen, TX 78550

Finding methods for riot control has become an increasingly important concern because of the deaths, injuries, and extreme property damage that can result in a riot. This two year study and project focused on an attempt to provide a valid method to predict outcomes of riots and a valid method to prevent the damage that might occur. A mathematical approach was used. Through the application of linear regression theories, a trend line of the original riots studied was found.

After research of five riots was completed, a method was needed that enabled the graphing of the riot cases. Some of the data obtained was large and did not permit easy graphing of riot statistics. This is where the weighting of the riot data became very useful. Analysis and comparison of the riot data obtained gave the basis for the developement of the system of weighting. Using the weighting specified in the system of weighting that was formulated, the riot data was converted. The weighted riot data was then placed through the formulas of linear regression to find a trend line.

A model, trend line, that had a good linear relationship was found. The correlation coefficient (r), a number between -1 and 1, measures the linear relationship of the riot data. The closer (r) is to 1 in absolute value the more pronounced the linear relationship of the points is. The (r) found was .88 . The (r) found supported that the method proposed was a valid approach in riot control.

#THE RESPONSE OF THE AFRICAN ELECTRIC CATFISH TO CHEMICAL CUES

Weinbaum, Alys E., Edward R. Murrow H.S., Brooklyn NY 11230
472 First St., Brooklyn, NY 11215

Strong electric catfish, Malapterurus electricus, live in the black or turbid waters of Africa. Because of the poor visibility in these cloudy waters, non-visual methods of communication are important. This experiment investigates chemical cues and electric organ discharges as methods of communication.

Strong electric catfish defend shelter areas (Rankin, 1984). The defense behavior of the fish depended on whether an intruder was a conspecific or a member of another species. For another species of catfish, the Bullhead (Ictalurus nebulosus), it has been shown that through chemical cues (amino-acid chains particular to each fish), that discrimination between various conspecifics and other species is possible (Todd, 1971).

In the present investigation the experimental animal was exposed to four different sets of chemical cues obtained from conspecifics and other species. The chemical cues were introduced in the form of treated/saturated shelters. Each of the twenty-eight trials was recorded on SONY videotape and the electric organ discharges were monitored with an auditory amplifier. The responses were measured for rate and duration.

The analysis of the data revealed that Malapterurus electricus is able to extract information from chemical cues. Future research will determine the extent of this fish's ability to distinguish among conspecifics and other species.

#Third Award - General Motors ISEF
Honorable Mention - American Psychological Association

TASTE WITH YOUR EYES

Day, Sharon, Millard High School, Fillmore, UT 84631,
P.O. Box 1415, Fillmore, UT 84631

Problem: Does color have any effect on the way food tastes? Do Cold colors seem to taste better than Warm colors or do Warm colors taste better than cold colors?

Hypothesis: I think Warm colored foods are more appealing to people because the colors give a sensation of warmth and comfort Cold colors on the other hand are generally dreary and not stimulating.

Procedure: My research consisted mainly of coloring neutral flavored foods and coloring them red, yellow, blue, and green, and having people sample them. The subjects were asked to taste the samples and specify a preference and flavor.

Observations: The response of the participants to the question about flavor was: 60% thought red was cherry, 20% thought yellow was lemon, 20% thought green was lime, 10% thought blue was blueberry. The response to the preference question was: 50% preferred red (warm color) 30% preferred green (neutral color) 20% preferred yellow (warm color), 0% preferred blue (cold color).

Conclusion: People prefer Warm Colors in foods. Warm colors are are more appealing and therefore are more appetizing.

THE EFFECTS OF DIETARY PHOSPHATIDYLCHOLINE MANIPULATION ON MEMORY

Author: Teresa Falck
School: Oelwein Senior High School, 315 8Ave. SE, Oelwein, IA 50662
Home Adress: 1111 1ST NE
Oelwein, Iowa 50662

The purpose of this study was to see if dietary phosphatidylcholine manipulation would have any effect on memory. The study used twenty standard laboratory mice, ten of which were a control group recieving pure water and the other ten recieving phosphatidylcholine in their water supply. The mice were introduced to a maze ten days after being put on their diets. The mice were run through the maze every 48 hours. The time it took for each mouse to complete the maze was recorded. Food was available to the mice when the exit to the maze was reached. This was done as a form of positive reinforcement. When this reward became ineffective the testing was stopped. The times were then compared. Through an independent t-test it was determined that there was no significant differnce in the times of the test group as opposed to the times of the control group. It was therefore concluded that the use of dietary phosphatidylcholine will not have a significant effect on the improvement of memory.

A Three Year Study of Fetal Auditory Imprinting

Shindler, Katherine, M., Northwest Rankin, Brandon, MS. 39042
417 Millrun Rd., Brandon, MS. 39042

The study of learning in animals is an important and vital part of behavioral experiments. The question of fetal learning and specifically fetal auditory imprinting is an area open to extensive investigation. This research is designed to determine if chickens can be imprinted to sound and variable sound frequencies during the embryonic stage and then respond to the specific sound upon hatching.

To establish positive auditory imprinting, each of three groups of fertile eggs were exposed to the sound of radio static, a high frequency sound (3000 Hz), and a low frequency sound (250 Hz). Another group was incubated with no sound to serve as a control.

To measure the response, each chick was placed in a Y maze with the various sounds projected at a given leg of the Y. The locomotor response of the chick proved that fetal imprinting did occur in each of the experimental groups.

In the third year of study, an attempt was made to imprint the chicken embryo to the sound of a specific natural predator. Five separate groups of fertile chicken eggs were used, four experimental and one control group. The first two groups were exposed separately during the embryonic stage to a mammalian predator, Felis rufus (bobcat) and Buteo lineatus (red-shouldered hawk) respectively. The third and fourth groups were exposed separately to combination sounds of each predator with the maternal sound.

Each chick demonstrated a positive imprinting response for the sound with which they were incubated by exhibiting a positive locomotor response when placed in a Y shaped maze.

This experiment indicates a need for additional investigation.

#First Award - American Speech-Language-Hearing Association
First Award - General Motors ISEF
First Award - United States Air Force
First Award - United States Navy/Office of Naval Research
Second Award - American Psychological Association
Honorable Mention - United States Army

A STUDY OF THE SYMBIOTIC RELATIONSHIP BETWEEN THE PEN SHELLS PINNA CARNEA AND ATRINA RIGIDA AND THE PEN SHRIMP, PONTONIA MEXICANA GUERIN AND THE CONCH FISH, ASTRAPOGON STELLATUS (Cope) IN SOUTHWESTERN PUERTO R#CO

Henriquez, Aner, Academia San Luis, Lajas, P. R. 00667;
Box 830, Lajas, P. R. 00667.

This study represents an attempt to describe the symbiotic relationship between the pen shells, Pinna carnea and Atrina rigida, the pen shrimp Pontonia mexicana Guerin and Astrapogon stellatus (Cope) in the shallow waters of southwestern Puerto Rico. One hundred and forty one pen shells were collected and 93 pen shrimps and 29 fishes were obtained from 3 stations.

Host specificity trials were conducted to test for the preference of shrimp and fish to wards its natural host, five different figures, eight colored pen shells, a rock and nothing used as a control. Pontonia mexicana prefered A. rigida with 86% in an average time of 0.55 seconds. This was followed closely by P. carnea with 85% in 1:32 second and the false Pinna with 89% in 2:01 seconds. A rectangle and a circle were also accepted. However, the rock was accepted 93% of the time in only 0:12 seconds.

Tests conducted to find out if the shrimp locates its host with natural environment using visual cues indicate that the shrimp appears to be attracted to the pen shells by visual recognition and that distance is an important factor. Preference for any color was negative. Tests conducted to see if angle of vision is an important factor in the location of their host, showed they can locate the host in any angle.

Tests conducted to determine if olfaction play a part in the location of its host showed it does not.

Same tests were carried out for Astrapogon stellatus with highly similar results. Association in both cases seems to be facultative commensalism. Astrapogon punctilatus (Poey) is reported for the first time as a facultative symbiont of both pen-shells.

HOW CHILDREN RELATE TO ADVERTISING WITH VISUAL, SOUND, OR WORD EMPHASIS

Foss, Pedar W., Hinckley H.S., Hinckley, MN 55037;
Rt. 1, Box 229, Sandstone, MN 55072.

The purpose of this project was to discover how visual, sound, or word emphasis in advertising affects children's consumer decisions. Three self-written computer programs were used in testing the subjects. One showed advertisements for cereal, another for gum, and the third for soda. These programs were utilized by an Apple IIe computer, green monitor, and disk drive. Each program showed three advertisements separately for nine seconds each. Then all three were displayed at once, and the subject chose the product he/she would "buy", based on the ads. One advertisement emphasized visual effects, another emphasized sound, and the third concentrated on words. 316 children, grades 1-6, took 3 tests each for a total of 948 results. The data was then statistically analyzed with the chi-square method, and was found to be significant. Probability of chance was less than 1/10 of a percent. Older children, grades 4-6, preferred ads that focused on words. Children in grades 1-3 favored advertisements with sound. Visual was second for both of the groups. The totals for the three categories were very close. Order of preference was: sound (34.5%), words (33.6%), and visual (31.9%). Conclusions: (1) Visual, sound, and word communication in advertising each had equal effect on the children's consumer decisions. (2) Words were favored by older children because they were understood easier. (3) An equal combination of all three mediums would be more effective in social applications, such as teaching techniques for educating children, public service announcements, and private advertising.

#Fourth Award - General Motors ISEF

TITLE: Effects of Caffeine on Human Learning
NAME: Chrissy Kirkmire
SCHOOL: Oregon Episcopal School
SPONSOR/TEACHER: Dr. William Lamb

The project was done to find out if caffeine affected student's learning ability. Twenty high school students were randomly assigned to one of four groups: (1) caffeine (100 mg) during study and caffeine during testing; (2) caffeine during study and placebo (baking soda) during test; (3) placebo during study and placebo during test; (4) placebo during study and caffeine during test. The caffeine and placebo were administered as gelatin capsules and could not be distinguished by appearance. Treatment consisted of having each student study a short paragraph and take a test the next day. The procedure was repeated, having subjects change groups, so that each student would experience each set of conditions and could therefore serve as his/her own control. All procedures were double blind. Analysis of variance indicated significant differences between groups. Paired t-tests showed that placebo/caffeine and caffeine/placebo were better than the other combination.

INTRODUCING MATH CONCEPTS WITH THE PERSONAL COMPUTER

Wayne, Dawn E., Victoria H. S., Victoria, TX 77901
207 Salisbury, Victoria, TX 77904

This study was concerned with the effects of introducing math concepts with the personal computer. The researcher selected five elementary age students for this investigation. Each was given a preliminary test to determine their math ability. Then a math concept above their grade level was chosen to be introduced by the home computer. Each student worked with their individual computer program and concept for ten minutes five days a week for seven weeks. Tests were given each five days to chart their progress. At the end of seven weeks the data consistently showed that learning had increased while the time to take each test had decreased.

TEENAGE VALUES

Potts, Keli A., Vinita High School, Vinita, OK 74301;
Rt. 2 Box 42, Vinita, OK 74301.

Greater understanding of teenage values are needed in order to develop more positive interactions between adults and teenagers, as well as greater teenage knowledge of peers. The purpose of this survey is to gather and present significant and current data of teenage values from a small midwestern high school. High school students (a total of 345, ranging in ages of fourteen to eighteen years old) were given ten questions regarding various significant issues of teenage values. The results show that the teenagers have a strong tendency for various traditional and stereotype values. The results are discussed in regard to changes that could be made in rewording certain questions and administering the survey to more populated cities and different geographical areas.

AN ALTERNATIVE MODE OF COMMUNICATION FOR A NON-VERBAL AUTISTIC PERSON

Ibrahim, Kevin, North Ogden Jr. High, North Ogden, Utah 84404
2569 North 600 East, North Ogden, Utah 84404

Using the computer's speech synthesizer, I prepared to see if it could replace a multe person's speech. I started teaching my subject the basics: matching, letter recognizing and signing. I then taught him to use a language board. I took the words from this and programmed a vocabulary into my computer along with a special coding system, especially designed for my subject. Data was taken on a daily basis to record trial and errors.

My subject did learn to use the computer to "talk" for him in a good and fast time because it usually takes months even years to teach an Autistic person even eye contact. We are presently expanding the vocabulary and speeding up the use of the computer

I have done my experiments so that others may use my findings, improve my program, and use my data to teach other autistic people to use a computer, so that we will be ready when a portable computer, that can be used in this same manner, comes out.

#THE EFFECTS OF PENTYLENTETRAZOL ON THE CATECHOLAMINE LEVEL IN THE CARASSIUS AURATUS BRAIN

Angela Philpot; Rockledge High School; Rockledge, FL 32955

Recent research in the field of the physiology of learning and memory by James McGaugh et al has shown that the level of catecholamines working in the brain immediately after a learning situation is higher than that of a normal subject. Past research by the experimenter has been with experimental amnesia induced with pentylentetrazol. This year the experimenter used the following procedure to determine if pentylentetrazol amnesia is caused by reduction of the catecholamine level. There were three groups of ten goldfish. Group one was trained to go to a lighted corner of a tank for feeding. Group two was also trained, and then given pentylentetrazol. Group three was a control. The three groups were sacrificed. The brain matter of each subject was exposed to dry formaldehyde gas, which makes the noradrenergic neurons flouresce. The amount of norepinephrine present after training (group one) was greater than that of the control (group three), supporting McGaugh's theory. If pentylentetrazol amnesia is a change in brain chemistry, then the second group should have fewer noradrenergic neurons than group one. This did occur, supporting the experimenter's hypothesis. A second set of tests was run following a revised procedure. In the new procedure, a fourth group that received an injection of sterile saline was added as a control. The same results were acheived, with the scores of the additional fourth group being similar to those of group one.

#First Award - American Psychological Association
First Award - United States Army
Scholarship - Ohio State University
Scholarship - United States Navy
Third Award - General Motors ISEF

GRAPHOLOGY, IS IT A SCIENCE?

Anderson, Holly Sue, Butterfield-Odin H. S., Butterfield, MN 56120
525 Elwell Ave., Butterfield, MN 56120

Graphology, the analysis of handwriting, is a permanently recorded expressive movement from which distinctive character traits of its author can be deduced. Following extensive library research, I chose thirty-two variables of script including such variants as those of letter size, margins, slants, zones, and the personal pronoun "I" as my tools of comparison. Next I developed an Apple computer program to not only add objectivity, but also to provide anyone with access to analysis.

Twenty plus subjects were involved. Upon completion of analysis, I made a survey of character traits on an either/or basis and each participant was asked to choose. From these self reports, I used the chi-square technique in determining contingency tables.

My objective was to prove the validity of the science, and my next step is to expand into child psychology and the doodlings of preschoolers in the United States. In Europe, degrees are given in the field and graphology is a required study for any person pursuing a psychology major. In the U. S., the practice has not reached its fullest potential, but it is expanding beyond employment personel screening into such areas as medicine, criminology, and counciling, and has much room for further study and further growth.

EFFECTS OF AGE, SEX, AND COLOR OF ILLUSION ON A PERSON'S ABILITY TO DISCERN OPTICAL ILLUSIONS

Melton, Mary Katherine, Manatee High School, Bradenton, FL 33529
204 77th Street W., Bradenton, Fl 33529

The purpose of this science project is to determine: do age and sex affect a person's ability to discern optical illusions; and does the the color of the illusion affect a person's ability to discern optical illusions?

After researching both optical illusions and color, a test was composed for this project. Phase I was researched and prepared for the 1983 Science Fair. Twenty six particioants ranging in age from 7 to 59 were tested and it was concluded that age and sex did affect a person's ability to discern optical illusions.

In Phase II, 25 persons were tested using red, blue and yellow illusions. Results of the tests, compiled in graph form, suggest that color did indeed affect the way that the participants discerned the optical illusions. Red illusions were most often chosen correctly where as yellow illusions were most often chosen incorrectly. Further more, when results of Phase II were compared to results of Phase I, it was noted that participants were more likely to correctly discern an optical illusion when the illusion was in black and white. The conclusion was drawn that color, as well as age and sex, can distort a person's ability to discern optical illusions.

RELATIONSHIP OF CEREBRAL HEMOSPHERIC DOMINANCE TO COMPATIBILITY: TWO YEAR STUDY

Wydoski, Susan Gail, Jefferson H.S., Shenandoah Junction, WV 25442
P.O. Box 1026, Shepherdstown, WV 25443

No abstract received.

C. MESOCRICETUS: WHAT IS IT, AND CAN IT LEARN?

Moritz, Valorie, Slayton High School, 2420 28th St., Slayton, MN 56172 _
Hadley, MN 56133

The purpose of my research and experimental project was to find if hamsters, a part of the sub-family Crisetinae, of the New World rat and mouse family, Cricetidae, are able to change their behavior and learn. Hamsters have helped man in many ways, including tracking bombs and drugs for the Armed Services and for experimental purposes. Through observation, experiments and research, I determined hamsters' behavioral traits, and which might help in finding if it could learn.

Using the habituation method, I rang a bell and fed the hamsters. All had responded by begging by the ninth trial. This verified findings of Frisch, Pablov, and Thorndike about other animals.

The next experiments concerned trial and error. I created a box maze with three tubes with a light above each. When a hamster entered a tube above which the light was lit, it received food. Accuracy for each participant was increased significantly.

I created and experimented with a large complicated maze. Those that had previously run other mazes did better than those that had no maze experience. This experiment covered four years and over 200 trial runs. Once each learned the maze, it ran better than earlier.

These findings aren't the first or last to be done concerning animals' ability to learn. The more we understand how animals learn, the more we can understand ourselves and contribute to society.

#CAN THE PSYCHOLOGICAL EFFECTS OF A TOUCH-SURROUNDED ENVIRONMENT IMPROVE THE ACADEMIC PERFORMANCE OF CHILDREN?

Wilkinson, Lora S., McLoud High School, McLoud, OK 74851;
Rt. 3 Box 231, McLoud, OK 74851.

I conducted over 30 experiment sets with first and second grade students. These experiments were classroom and reading experiments which were used to determine the children's reactions to touch in two types of environments: classroom and individualized instruction(reading).

From these experiments I have found results that most likely occurred because of a significant variable rather than chance. These are my conclusions: 1. Children used in a previous year's experiments were affected by touch the same as their first year of participation in the research. 2. The classroom population was not significantly affected by touch; however, those positively affected were significantly affected. 3. Without a level of frustraion the children positively or negatively affected were still significantly affected by touch. 4. The number of children positively affected by touch tended to be smaller than the number of children negatively affected by touch; however, this was not true if I was familiar with the children prior to the experiments. 5. I did not find a significant difference between the standard deviations of the touched and untouched means of the subcharts. 6. I did not find that the level of significance differed significantly between reading and classroom experiments. 7. I did not find that the teacher's results were more significant than my results if I was familiar with the children prior to the experiments.

These results have encouraged the acceptance of the directional hypothesis: The effects of a touch-surrounded environment improve the academic performance of first and second grade children.

I extend my thanks to the following sponsors: Hasty Transfer & Storage, Terry Hopkins, D.D.S., Sr. and Jr. High McLoud Science Clubs, McLoud Lions Club, Bird's grocery, Gerald Knight, attny., Michael Whinery,D.O., McLoud Phone Company, and Nawakowski Oil Company.

#Third Award - General Motors ISEF

THE EFFECTS OF HYPERTHYROIDISM ON TASTE DEVELOPMENT AS MEASURED BY INTAKE AND BEHAVIORAL RESPONSES TO ORAL INFUSIONS OF QUININE IN THE RAT PUP

Kent, Leslie L., Ely High School, Pompano Beach, Florida 33060

3810 N.W. Fourth Avenue, Pompano Beach, Florida 33064

The purpose of this study is to show the effects of hyperthyroidism on the development of taste sensitivity and the development of aversive behaviors to a .2% quinine solution in the rat pup. Four litters of rat pups were used in this study, each litter consisted of ten pups. Half of the pups in each litter were made hyperthyroid by daily subcutaneous injections of thyroxine (T_4), while the other half of the pups in each litter were control pups and were given daily injections of a saline solution. At 8, 10, 12, 14, and 16 days of age, two pups from each litter (one hyperthyroid pup and one control pup) were tested for their taste sensitivity and their aversive behaviors to quinine. Fifteen to thirty minutes prior to testing, pups were implanted with an anterior oral cannula, through which infusions of a .2% quinine solution were made. Five infusions were made, one every two minutes for ten minutes, which made a total of 4% of the deprived pups' body weight The pups' behavioral reactions to the quinine solution were scored every 15 seconds throughout the test. The pups' intakes were measured after the test.

Both the hyperthyroid and the control pups depressed their intake and their mouthing to the quinine solution at 12 days of age. Adult-like aversion responses of paw treading and chin scraping were emitted almost continuously while quinine was being infused by control pups at 14 days of age and by hyperthyroid pups at 12 days of age. Rejection of quinine became more vigorous with age in both the control and the hyperthyroid rat pups. Measures of intake and of mouthing indicated no acceleration of the development of taste sensitivity in hyperthyroid rats. However, measures of aversive behaviors were accelerated.

TITLE : BIORYTHM POSSIBLE EFFECTS IN HUMAN BEHAVIOR

AUTHOR : ZAYDA PEREZ
SCHOOL : ACADEMIA NUESTRA SEÑORA DE LA PROVIDENCIA
HOME ADDRESS : 4th ST. S2 #14 VILLAS DEL PARANA
RIO PIEDRAS, PR 00926

The purpose of this study is the corroboration of the possible relation of BIORYTHM with school achievement and with accident proneness. Also, the speed of the calculation of BYORYTHM thru the use of a computer, was tested. Three cycles or rythms are present in the human body, influencing the level of the physical, emotional and intellectual condition of a person. Knowing the exact date of birth of a person, his three cycles may be calculated with precision. A statistical analysis was used as a means of evaluation of the data gathered. The results of three exams given to a group of 27 high school students and twelve cases of bone fractures were compared to the indications of their respective BIORYTHMS (intellectual cycles and physical cycles) on the dates under study.

On 74% of the student cases studied, some relation between the position of the intellectual cycle and the results of the exams, was shown to be present. On 67% of the bone fractures cases, the position of their respective physical cycles was shown to be down or critical on the corresponding date. The calculation and the production of the printed graphic for each case was done in an average time of 1:45 minute thru the use of a computer and an adequate program prepared for it. The conclusion was that the BYORITHM indication has some influence in most of the cases on how the condition and behavior of a person will probably be on a certain date; advance knowledge of the byorithmical condition of a person may help that person to control his behavior on the specific date.

DOES WORD SIGNIFICANCE, GROUPING, AND SERIAL POSITION AFFECT THE HUMAN BRAIN'S RECALL ABILITY?

Scearce, Kimberly A., Thomas S. Wootton H.S., Rockville, MD 20805
743 Beall Ave., Rockville, MD 20850

The purpose of this experiment was to determine the relationship between human memory and the significance, serial position, and organization of syllables to be memorized. It was hypothesized that recall would increase as word significance and organization improved and that syllables near the beginning or end of test lists would be most easily recalled.

Word lists were developed for three separate categories; Nonsense Syllables, Meaningful Words and Related Words. Each of these categories were represented by two lists, one structured and one unstructured. Individual tests, consisting of the six lists and standardized test instructions, were administered to 25 homogeneously selected subjects. As the test monitor read the words aloud, test subjects looked at the list. Immediately after the monitor read the last word on a list, test subjects recited all words they could recall. The test on each list was repeated immediately as a measurement of retention.

Results showed nonsense syllables were most difficult to recall, unrelated real words were somewhat easier, and related real words were the easiest. Organization had little or no effect on recall ability. As hypothesized, recall was generally highest for the first and last words on a list. Significantly, an unexpected peak in recall ability consistently appeared in the middle of each word list. This occurance may be explained by the possibility that the brain automatically breaks down long lists into smaller sub-lists. Where these breaks occur, the words stand out as markers to the brain.

AI (ARTIFICIAL INTELLIGENCE) - CAN A MACHINE THINK?

Smith, Tyler E., McCants Jr. H.S., Anderson, SC 29621
105 Carter Oaks Drive, Anderson, SC 29621

The concept of Artificial Intelligence, AI, is fascinating to many people. The idea of a computer, a mere box of parts, which demonstrates abilities that we have always considered human, is staggering to most of us. The subject becomes even more amazing when we consider that many computer scientists believe computers may be able not only to imitate human traits, but improve upon them.

My project is an attempt to demonstrate the ability of a machine to do these things, and I will base my conclusions on research and sample programs.

My programs illustrate four major areas of AI:

1) Game Playing: The familiar computer game, yet with more reasoning power than the standard alpha-beta or tree type "scan".
2) Natural Language Processing: Attempts to make computers "understand" human languages. NLP is an essential factor in AI. It allows for a link between man and machine.
3) Problem Solving: Involves use of known principles in the exact sciences such as mathmatics and physics.
4) Pattern Recognition: Giving a mass of raw data to the computer in which there are certain patterns the computer must be able to interpret in order to process data.

I hope to demonstrate some of the basic principles of a method which might address the question, "Can A Machine Think?".

INTERSPECIFIC COMPETITION AS A CAUSE OF POPULATION DISPLACEMENT IN THE GENUS ANOLIS

Babbitt, Shannon E., Kathleen Sr. High, Lakeland, FL 33805;
2501 W. Cresap St., Lakeland, FL 33801

Competition between similar species occupying the same area can be detrimental to the survival of either or both. Two similar species in Central Florida are the lizards Anolis carolinensis and Anolis sagrei. Because of the similarity of their ecological demands, these two species must diverge; otherwise, one will be displaced. Observations and research have led to the hypothesis that Anolis carolinensis, the native anole of Central Florida, is being displaced by Anolis sagrei, an introduced species from Cuba. To approach such a hypothesis, a study was conducted on the sympatric species Anolis carolinensis and Anolis sagrei from August 29 through December 31, 1983. During this time, observations were made at separate study sites on the campus of Kathleen Senior High School and at a residence on the west side of Lakeland, Florida. Brach (1977) stated that he has observed anoles over the last twenty years and has come to the conclusion that Anolis carolinensis is being rapidly displaced in South Florida by newly introduced anoles, esp. Anolis sagrei. Members of the species Anolis carolinensis were the only representative of the genus Anolis in Central Florida until the introduction of Anolis sagrei in Tampa and St. Petersburg (Carr, 1969). Thus, before this introduction of Anolis sagrei, Anolis carolinensis was the dominant species. Since the introduction, however, the population, as well as the range, of Anolis sagrei has increased. This project intends to present data ultimately suggesting that the presence of Anolis sagrei is detrimental to the survival of Anolis carolinensis in Central Florida.

WHO DECIDES FOR YOU?

Lyman, Leanna M., Highland S.S., Dundas, Ontario. L9H 5E5
111 Fairleigh Avenue, South, Hamilton, Ontario. L8M 2K4

The social psychological term, conformity, means some behavioural or attitudinal change that occurs as a result of some real or imagined group pressure.

The purpose of this field survey was to explore how people yield to group pressure when no direct request to comply has been made.

It was hypothesized that the decision of the majority, implied by the presence of the existing confederate signatures on the surveys, would influence the subject to conform to popular opinion if the question were of a neutral tone, and of a topic with which the subjects were unfamiliar. However, if the subject was familiar, the opinion would not be altered by the confederate majority.

Validation of the two questions to be used was established by means of a pilot study, involving a two-strand five-point Likert scale to establish both neutrality and familiarity. The variables of weather, sunny days and overcast days, the questioner's attire, bright, attractive, dirty, slovenly, were utilized. The affects upon the respondents were noted.

The results were striking, simply because they were exceptionally consistent. One may conclude that the complexities of modern society have increased the need for individuals to rely upon others. People seem to develop a strong need to be personally and socially "correct" in both their behaviour and opinions.

Regardless of the variables, increases in susceptibility appeared when an individual was uncertain, uninformed, or when objective cues were presented to aid him. Opinion poles and consequence policy may be distorted by subtle manipulation of the variables of weather, appearance, and confederacy.

THE EFFECTS OF ALCOHOL ON BRAIN ACTIVITY

Hall, Gary L., Lisbon H.S., Lisbon, North Dakota 58054
312 7th Ave. W., Lisbon, North Dakota 58054

The purpose of this lab was to study the effects of alcohol on brain activity.

It was hypothesised that after the introduction of alcohol the mice would show a decrease in their ability to run through a maze, thus showing a drop in their brain activity.

Four mice were used in this experiment and run through a maze. Their times in the maze were recorded to be used in comparing a mouse's time to its time in later trials. The first part of the experiment was used to find each mouse's ability to run through the maze, this was done by running each mouse through the maze ten times with no outside factors influencing them. The second part of the experiment was used to test the effect the alcohol would have on two of the mice's maze time. The control mice (#3 and #4) were run in the maze as the first part of the experiment. The test mice (#1 and #2) were each given one milliliter of beer before each trial.

The results obtained were as follows: Mouse #1 (test)-This mouse showed a drop in its ability to run through the maze after the alcohol was given to it; Mouse #2 (test)-This mouse also saw a drop in its ability to run through the maze after it had the alcohol; Mouse #3 (control)-This mouse kept its time in the maze approximately the same through all twenty trials; Mouse #4 (control)-This mouse showed its same ability all through the experiment.

It was concluded, from these results, that alcohol was the slowing factor in the abilities of mice #1 and #2 to run through the maze.

BIRD BEHAVIOR IN RELATION TO FOOD TYPES

Kim Michel
St. Clair High School
Rt. 1 Box 29
Eagle Lake, MN 56024

This experiment was performed to determine if various species of birds prefer certain food types as opposed to others. Also to determine if birds are affected in their behavior by other birds while they are feeding.

To make adequate conditions for observing, a feeder was designed and constructed with seven separate feeding compartments which were filled with several different food types. Alphabetic symbols were placed below each compartment to allow the observer to determine which food type each bird species prefers. The feeder was placed in a spot that permitted close observation with a minimum of disturbance. Observations were made and recorded in relation to the food they preferred and the way they behaved while feeding. Pictures were taken with a 35 mm camera while the different species of birds were feeding.

The results were recorded on charts and graphs showing A) which food(s) each of the six bird species preferred, B) the average amount of minutes each species stayed at the feeder per visit, C) how many times each bird species visited the feeder during the observation time, and D) their specific behavorial patterns while feeding.

Observations in my study support the theory thay birds do have a preference for certain foods and feeding behaviors. Many birds feed on elevated structures while others prefer to feed on the ground. Evidence was also gathered that birds sometimes show a dominance over others while feeding.

A SINISTER STUDY

Conley, Alicia Anne, Albemarle H.S., Charlottesville, VA 22901
1771 Old Brook Rd., Charlottesville, VA 22901

PURPOSE: To provide support for the Levy theory that left-handers fall into two distinct classes that reflect brain organization. HYPOTHESIS I. Hooking left-handers (HL) and non-hooking left-handers (NHL) will have a significantly different number of left and either responses on a hand use questionaire. HYPOTHESIS II. There will be a significant difference among the three groups (control right, HL, NHL) in respect to number of left-handed relatives.
PROCEDURE: Subjects - 60 adolescents (20 right, 20 HL, 20 NHL) A questionaire was administered to each of the subjects and genetic data, hand use, mixed dominance, and Torque Test information obtained.
ANALYSIS: Statistical analysis showed the three groups to be significantly differentiated by number of left-handed relatives. ALL of the left-handed relatives of those in the NHL group were non-hooking, and all but two of the left-handed relatives for the HL group were hooking left-handers. In addition, ALL of the left-handed relatives for the females in the NHL group were also female and ALL of the left-handed relatives for the males in the NHL group were male, with similar results for the HL group. Significant t-tests of the hand-use questionaire results clearly indicated that there were two distinct groups of left-handers, and that the NHL were as well lateralized as the right-handers.
CONCLUSION: This study supported the genetic basis of handedness and contributed additional support to the Levy theory that left-handers fall into two distinct classes (hooking and non-hooking) by showing that the two groups can be significantly differentiated by the hand-use questionaire and the genetic background data.

WHAT SLEEP POSITIONS REVEAL ABOUT US

Domeier, Lisa L. Fairfax Public School
612 So. Park St. Fairfax, Minn. 55332

The purpose of my experiment is to see how the night language of the body reflects the way we live.

To start my experiment I stayed up all night surveying five individuals to see what positions they were in. By this I could find out what sleeping position was most favored by each. Then I stayed up a second night to see if their most common position was favored again. From this I was able to tell what kind of person they were during the day.

I found that the people I surveyed stayed in one position most of the night. I had one exception, an eighteen month old child, who slept in the royal position the first night and the prone position the second night.

The position a person sleeps in does reflect what kind of person they are during their waking lives.

#PERSONAL SPACE IN CHILDREN: DEVELOPMENT AND PERSONALITY CORRELATIONS

Brown, Patricia L., Snider H.S., Fort Wayne, In. 46815
3123 Bellshire Way, Fort Wayne, In. 46815

The purpose of this experiment was to answer these questions concerning personal space. Does the concept of personal space develop and change as a child matures, or is it innate and static? What influence, if any, do age, race, and sex have on personal space? Does personality type influence personal space?

The Comfortable Interpersonal Distance Scale and Junior Eysenck Personality Test were administered to 56 children in grades kindergarten through third. Analysis of results suggests that personality type does influence personal space; those with a tendency toward extroversion desired a greater area of personal space. Also, age, race, and sex do seem to influence personal space. Finally, ideal personal space zones indicated by the children developed and changed as the age of the test group increased.

#Fourth Award - General Motors ISEF
Honorable Mention - American Psychological Association

A STATISTICAL ANALYSIS OF WORD PATTERNS: THE TYPE-TOKEN RATIO AS A METHOD OF INDICATING CONDITION OF MORALE

Sanchez, Pola E., Union County High School, Lake Butler, Florida 32054
P.O. Box 237 Lake Butler, Florida, 32054

This project involved the statistical analysis of word patterns. In this study, two subjects were subjected to analysis. The first was John Winthrop, governor of Massachusettes. Examined were 20 of his personal letters between the years 1630 and 1638. The second was the six month diary of Carl McCunn, a man who was accidently left in the Alaskan wilderness. The diary tells of his hardships during his last cold and starving months until his suicide in 1981.

The problem was this: Would it be possible that under a statistical analysis having to do with word diversity, could a personal writing reveal something about the condition of morale of the writer? In this case, it was hypothesized that stress might be detected with higher word diversity, and complacency found with lower diversity, hence, lower TTRs, or Type-Token Ratios, which is the statistical method that was used.

In conclusion, it was found that this method for finding a word pattern did show correlations between condition of morale and word diversity in these particular cases.

#OBSERVATION OF HUMAN REACTION TIMES TO ANALOG AND DIGITAL DISPLAYS

Herbert A. Spies
Niceville Senior High School
31 Holly Avenue
Shalimar, FL 32579

The purpose of this project is to try to determine human reaction times to analog and digital displays. In the recent past many new automobiles and aircraft have come out with new and so-called better, digital displays. In this project I hope to show which of the two displays, analog or digital is really better.

A computer will be used to display various analog and digital displays of common gauges. Time for the subject to read the gauge will be measured. Subjects will then have to input the reading in order to verify the gauge was read correctly. A sample size of 50 subjects will be used. Mean and standard deciation will be calculated for each subject's reaction times to analog and digital displays.

#Honorable Mention - National Aeronautics and Space Administration

#SOCIAL BEHAVIOR OF ADULT FEMALE BACTRIAN CAMELS AT THE MINNESOTA ZOO

Kain, Susan M., Edina H. S., Edina, Minnesota 55435
4949 Abbott Avenue South, Minneapolis, Minnesota 55410

Four adult female Bactrian camels (Camelus bactrianus) were observed at the Minnesota Zoological Garden from January to April of 1983. During the 135 hour study, recording observational data took 30 hours. Statistical calculations indicate that no social hierarchy exists among the adult female camels.

#Fourth Award - General Motors ISEF

DO SOUNDS AFFECT A CHILD'S PERFORMANCE?

Hatch, Tracy L., Slayton Central H.S., Slayton, Minn. 56172
3203 29th Street, Slayton, Minn. 56172

The purpose of this experiment was to find out if rock music, soft music, everyday noises, and quiet affect the learning ability of children.

In this experiment, thirty children from third grade and thirty children from fifth grade found their way through different mazes (all of the mazes were of the same difficulty) and read stories after which they answered questions. While doing these tasks, they listened to rock music, soft music, everyday noises and also did the tasks when it was quiet. The experiment compared the affects the different sounds had on the children by timing them on each exercise.

The results of this experiment were unexpected. When the children did mazes while listening to soft music, they completed the exercises more slowly. When they read stories and did questions while listening to rock music, they took more time to complete the exercises. In both of these experiments the timed results were faster when it was quiet and also when everyday noises were being played.

The conclusions of these tests indicated that soft music and rock music tended to slow down the completion time of the exercises. With the everyday noises and quiet, however, the exercises were completed faster.

THE FHL SYSTEM: ISOLATION OF THE HYDROGENASE OPERON

Nicole Calakos, Boca Raton H.S., Boca Raton, FL 33432
1520 S.W. 13th Drive, Boca Raton, FL 33432

When probing alternative fuel sources, the production of hydrogen by microorganisms is potentially more economical. Most research of this topic has been in determining those microorganisms with the optimum hydrogen evolution. However, this research takes this one step further and considers enhancing the biochemical system responsible for hydrogen evolution by methods of genetic manipulation.

Before genetic manipulation can be done, it is necessary to understand the genetic mechanisms of the system, namely the Formate Hydrogenlyase System. The first step is to understand the genetic mechanisms of an essential enzyme, hydrogenase. The ideal way to study the DNA responsible for hydrogenase synthesis is to isolate it and form a plasmid with it.

In order to identify the desired genetic material, transformations were done with E. coli strains mutated for a deficiency in hydrogenase synthesis and hydrogen evolution. Genetic complementation was tested for by enzyme assays and gas chromatography. If the plasmid complemented the mutation, the plasmid was reisolated and its molecular weight was determined using DNA gel electrophoresis.

Two plasmids with optimal size and location have been isolated. One plasmid is needed before the fusion of the hydrogenase operon plasmid may occur. In addition, the Multiple Promoter Hypothesis was developed due to a discrepancy in the results of a transformation.

DESMOSINE AND ISODESMOSINE IN THE MEMBRANE OF THE HEN EGG

Biederstedt, Randal D., Harrison H.S., West Lafayette, IN 47906;
4810 Homewood Drive, West Lafayette, IN 47906.

The amino acids desmosine and isodesmosine were originally thought to be present only in the presence of the protein elastin, however, in the inner shell membrane of the chicken egg, desmosine and isodesmosine have been found to be present in the membrane in the absence of elastin. To test this contraction, it was the purpose of this research to examine the level of desmosine and isodesmosine in the inner shell membrane of the hen egg over incubation.

Samples from days 1, 12, and 18 of incubation were initially tested for a significant change over that time period. The samples were extracted from the egg, dehydrated in ethanol, and hydrolyzed. Standards of the amino acids desmosine and isodesmosine were obtained and put through the analyzer. The hydrolyzed samples were then placed in the amino acid analyzer for analysis. The concentrations of the two amino acids on each day was found and the relative value was compared between days. Results show that although desmosine and isodesmosine are present over the time period of incubation, there is no change in the amount of the amino acids over incubation.

#A SCREENING OF CRUSTACEAN EYES FOR THE PRESENCE OF PTERIDINES USING PAPER CHROMATOGRAPHY

Fernández, Rafael, Colegio San José, San Germán, P.R. 00753; Carr. 102, Km. 36 Hm. 8, San Germán, P.R. 00753.

Pteridines function as important eye pigments in insects, occurring with ommochromes in the accesory pigment cells separating different ommatidia and carrying out the function of screening pigments. To isolate unconjugated pteridines from the eyes of 28 different species of Crustacea, ascending monodimensional paper chromatography was used with n-propanol: ammonia 1% (2:1) as solvent. The eye (or its extract after maceration if too large) was placed directly on the paper and the chromatography carried out in a light-proof tank. Chromatograms were examined under UV light and spots were identified whenever possible using as control a D. melanogaster chromatogram that had run at the same time. Crustacean and Drosophila eye sections were prepared using FAA as fixative and Mallory's Triple for staining. Staining of ommatidial structures and the location of pigment granules was recorded. Pteridines were found in 27 of the 28 species examined. Equally stained pigment granules were found in homologous cell structures (secondary pigment cells) in both Drosophila and crustaceans. When separated with n-propanol-ammonia as solvent, each crustacean species appears to have its own distinctive pattern.

#First Award - Eastman Kodak Company
Honorable Mention - American Optometric Association and Auxiliary to the American Optometric Association

DETECTION OF AROMATIC HYDROCARBONS IN THE SALIVA OF SMOKERS

King, Chuck E., Springdale H.S., Springdale, AR 72764
Rt. 3 Box 173 King's Rd., Springdale, AR 72764

A large percentage of oral/oropharyngeal cancer cases occur as a result of the polycyclic aromatic hydrocarbon benzo(a)pyrene (B(a)p). Even a larger percentage of these cases involve cigarette smokers. Experimentation in this project involved qualitative/quantitative analysis of the carcinogen B(a)p in the saliva and sputum of tobacco smokers. PHASE I experimentation used qualitative analysis to detect levels of B(a)p in the saliva of cigar, cigarette, and pipe smokers by means of a nitration process and by combining the solid particles in the saliva with sulfuric acid. Tests showed levels of B(a)p in the cigar, cigarette, and pipe smokers by a typical three-layer nitration arrangement. Similarly, PHASE II not only yielded the same results in 3 ml of saliva but also showed levels of B(a)p in the saliva of a non-smoker exposed daily to moderate amounts of the carcinogen--suggesting that one needn't be a smoker to contain levels of B(a)p in the saliva from cigarette smoke. Quantitative analysis in PHASE III showed a level of 65 mg of B(a)p per 3 ml saliva from the heaviest smoker and 10 mg/3 ml in the non-smoker--both amounts exceeding the levels known to cause tumors in intratracheal administrations to monkeys (Crocker, et al.). PHASE IV involved in vitro adsum injection of a non-smoker's saliva with varying amounts of smoke from the cigarettes usually smoked by PHASE III donors. It was found that as more smoke was added, the level of B(a)p increased. This supported the PHASE III hypothesis that amount smoked serves to determine B(a)p levels. These findings present a new angle in oral carcinogenesis--the saliva as a vehicle for carcinogenic metabolism and transmission--and demonstrate that possibly harmful levels of a known carcinogen may be found in the saliva of tobacco smokers.

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY ANALYSIS FOR PSORALENS

Yakesch, Russell L., Rockdale H. S., Rockdale, TX 76567
Rt. 3, Box 159, Rockdale, TX 76567.

The purpose of my project is to determine if psoralens are present in three Texas plants and in human foods.

I obtained three small samples of plants of the family Umbelliferae and also obtained V-8 juice, an orange and a grapefruit. I took 20 mg samples of each and made two replicates of each. Extraction was carried out with 20 ml of ethyl acetate in each replicate. The extracts were then filtered under vacuum into a pear-shaped flask. The extracts were concentrated to dryness using a rotary evaporator. The residue that resulted was dissolved in 2 ml acetonitrile and then 2ml of water was added. This solution was passed through a C_{18} SEP-PAK. High Performance Liquid Chromatography was then used. I injected 20 ul of each into the machine for analysis.

After viewing the results, neither plant showed any detectable levels of psoralens present. The foods showed slight traces of psoralens present. The sensitivity levels of the plants are 5 ppm while the sensitivity levels of the foods are 20 ppm.

Psoralens are biologically active compounds and their potential significance as human health hazards is beginning to recieve considerable attention. More attention is now being focused on the evaluation and occurrence of psoralens in human foods.

DOES STARCH BLOCK PREVENT STARCH FROM BREAKING DOWN INTO A SUGAR?

Lowe, Kris C., Manatee High School, Bradenton, FL
3801 Sandpointe Dr. W., Bradenton, FL 33505

My project, "Does Starch Block Prevent Starch From Breaking Down Into A Sugar?" is a study into the world of enzymatic digestion. The objective of this project is to see and prove the effects of the dietary starch block sold by the national market and through doctors' prescription does "prevent starch from creating Calories that in the body will cause fat," and to see if this breakdown in the body into simple sugars is actually prevented; therefore, the starch would literally pass out of the body as waste since starch is too complex to be utilized by our systems. I have tested the accuracy of this produce by introducing three different enzymes: bacterial amylase, fungal alpha-amylase, and amyloglucosidase. Each of these enzymes are found in the body, and each aid in the conversion of starch into sugar. After the starch is placed in the influence of the enzymes, the amount of sugar present at the end is quantitatively recorded. In order to have a control and a variable, the first three specimens consist of starch that has been gelatinized to allow the hydrolysis of the starch to promote the breaking down. Three separate specimens were then made with gelatinized starch and starch blocker. The first set of starch samples consisted of the starch, starch blocker, and bacterial amylase, a lower enzyme that does not digest starch very thoroughly. The second set was then introduced to a stronger enzyme, fungal alpha-amylase. Thirdly, the last set was introduced to amyloglucosidase. Each of these was then recorded by taking the difference of the two corresponding samples.

PHOTOPRODUCTION OF HYDROGEN BY MARINE ALGAE

Gray, David Alan, Hudson High School, Hudson, Fl 33567
8809 Village Mill Row, Bayonet Point, Fl 33567

The purpose of this project is to determine if it is possible to use various marine algae as potential sources of hydrogen production. Originally a laboratory curiosity, this phenomenon has taken on new significance as the world searches for new and renewable sources of energy. Hydrogen production by photosynthetic systems has become an active area of research only during the past few years and utilization of marine cultures have been researched an even shorter period of time. Since little research was available, existing techniques were modified substantially to produce hydrogen from marine algae in a home laboratory.

Eleven species of red, brown and green marine algae were cultured. Nine species grew sufficiently to be tested. (Growth of the algae to at least five square inches was set as a minimum before testing.) The green algae appear to be much more suitable for the project due to their chlorophyll content. Five variety of green algae have produced small amounts of hydrogen in the light after a period of 3 to 4 hours of dark anaerobic adaptation. Two green varieties, chlamydomonas and cladophora, appear to be especially interesting due to their sustained rate of hydrogen production in amounts more then twice that produced by the same quantities of other algae tested.

Such results give increased importance to continued study. It appears that an artificial photosynthetic production of hydrogen from anaerobically adapted marine algae does represent an intriguing way to capture and convert marine algae into energy rich hydrogen. And, the potential energy consequences for significant commercial production of hydrogen from an abundant source of supply that is continuously renewable are tremendously exciting.

#First Award - U.S. Department of Energy
Third Award - Marine Technology Society/U.S. Naval Institute
Honorable Mention - National Aeronautics and Space Administration

THE NUCLEAR GENE CONTROL OF MITOCHONDRIAL RIBOSOMAL PROTEINS: AN IMMUN-BLOT ASSAY

Tseng, Anne A., Highland H.S., Highland, IN 46322
3018 44th St., Highland, IN 46322

Chloramphenicol and ethidium bromide, inhibitors of mitochondrial protein synthesis, were used to determine: (1) whether the mitochondrial ribosomal proteins (MRP) are encoded by the nuclear genes in Neurospora crassa mutant nuc-1 and (2) their effect on the production of MRP. Cytoplasmic and mitochondrial proteins were extracted from control and treated cells and separated by polyacrylamide gel electrophoresis. One slab gel was stained with Coomassie blue for visualisation of the total protein pattern, and the other was transferred to a nitrocellulose membrane. This was followed by the detection of MRP via antibody binding and subsequent enzymatic staining reaction. The high efficiency of the ethidium bromide induction of MRP provided evidence that at least some nuclear coded mitochondrial ribosomal proteins were overproduced. The synthesis of these proteins may be controlled by a repressor which inhibits nuclear protein synthesis. When mitochondrial protein synthesis is blocked by ethidium bromide, no repressor is formed. Consequently, MRP are synthesized uncontrollably in the cytoplasm.

#Fourth Award - General Motors ISEF

THE ANALYSIS OF DNA REPAIR AFTER GAMMA RADIATION EXPOSURE

Audi, Steven A., Brunswick H.S., Brunswick, OH 44212;
85 Vineyard Dr., Brunswick, OH 44212.

The purpose of this project is to determine whether or not DNA can repair after having become cross-linked with the protein in the cell. This DNA protein cross-linkage is caused by gamma radiation exposure.

First, two strains of mouse lymphoma cells were cultured. One strain is sensitive to gamma radiation. The other is slightly more resistant to gamma radiation. After culturing, all the cells, except the control group, were irradiated with a gamma radiation dose of 60 Gray. After irradiation, the cells were allowed to incubate for various periods of time. Thus, allowing for possible DNA repair to occur. Any repair which might have occured would then be measured.

Results have shown that in fact DNA can repair from protein cross-links which were caused by gamma radiation exposure, if the cells are allowed incubation time for recovery.

AN INVESTIGATION INTO THE MEMORY RETAINING POTENTIAL OF RNA

Neumann, Teri. Franklin County High School, Winchester, TN
Route 1, Box 137-A, Estill Springs, TN 37330

The purpose of this experiment was to determine whether RNA is or is not a memory-retaining agent. In order to accomplish this, a control group of three laboratory mice(Mus musculus) were exposed to a maze, with each mouse receiving three conditioning exposures (reinforced by a trail of food leading to the end of the maze) and ten unaided learning exposures. After each mouse in the control group had completed the allotted number of exposures, these animals were sacrificed and RNA extracted from the brain tissue. The RNA was injected into three experimental mice, which were then given the same conditioning procedure and unaided learning exposures as the control group. The average learning times for each group were calculated and compared. Upon comparison, it was discovered that the experimental group had learned the maze an average of 50.73 seconds faster than the control group. Therefore, RNA may retain memory.

EFFECTS OF ALUMINUM BINDING IN ALZHEIMER'S DISEASE

Henderson, H. Jefferson, Farragut H.S., Knoxville, TN 37922;
1259 Lovell View Dr. Knoxville, TN 37922

Previous testing indicates that elevated aluminum levels are associated with neurofibrillary tangles in Alzheimers Disease. In phase one tests were conducted to determine the aluminum content in some popular beverages. It varied between 235 nM and 9020 nM. From the phase one data, it appears that the diet is a major contributor of the aluminum ions which accumulate in the brain of Alzheimers patients. In phase two tests were conducted to determine if aluminum would bind with the protein ferritin. After trial testing showed that aluminum will bind tightly with ferritin, further testing was conducted to determine the maximum number of moles of aluminum that will bind with one mole of ferritin.

ARE PLATELET MYOSIN LIGHT CHAIN PHOSPHATASES REGULATED BY cAMP?

Heinze, Kimberly D., Okeene H.S., Okeene OK. 73763
Rt. 2 Box 28A1, Okeene, OK. 73763

Previous studies have established the phosphorylation response to activation of platlets utilizing stimulation by arachidonic acid. The response is the result of calcium ions released from the dense tubular system into the cytosol. Phosphorylation of protein is measured through ^{32}P incorporated into peptides resolved on sodium dodecyl sulfate electropnoresis gels (SDS-PAGE). Of particular signifigance to the hypothesis being tested in this study are the elevated phosphorylation counts per minute of the myosin light chain, following activation by arachidonic acid, and the decreasing counts following addition of PGI_2 causing an elevation of platelet cytosol cAMP. PGI_2 reversed activation and inhibited normal platelet response to activators. Associated with this PGI_2 treatment is the increased phosphorylation of a 22 and 24 kilodalton peptide. Two suggestions have been made regarding cAMP inhibition, the first being that myosin kinase (130,000 dalton peptide) is itself being phosphorylated and thereby inactivated.

The second suggestion is that the 22 kilodalton phosphopeptide mediates increased calcium uptake by the dense tubules. Neither of these suggestions have been previously experimentally proven.

This study explores the potential role of c AMP on the regulation of myosin light chain phosphatase subunit or through a cAMP binding regulatory subunit.

PRODUCTION OF MONOCLONAL ANTIBODIES TO ERYTHROPOIETIN

Kwock, Denny W., Kalani H.S., Honolulu, HI 96821
862 Ahuwale St., Honolulu, HI 96821

Monoclonal antibodies involve a technique which exploits the monospecific nature of antibody production by lymphocytes. Lymphocytes are fused with myeloma cells of similar genetic origin, resulting in a hybrid cell. Hybrid cells lines will grow in vitro and are monospecific in terms of antibody production, hence, a monoclonal antibody.

Erythropoietin (EPO) is a hormone responsible for the proliferation and differentiation of erythrocytes (red-blood cells). A small quantity of crude sheep EPO, 5-8 micrograms active material, has been isolated through stepwise chromatography techniques. Some of this was applied toward a series of immunizations in a Balb-C mouse. The murine lymphocytes were subsequently fused with P_3 myelomas and assayed by means of an in vitro biological assay. This assay relies on a monoclonal antibody's potential ability to negate proliferation and differentiation of stem cells into erythrocytes in the presence of sheep EPO. Assays of hybrid cell lines isolated through limited dilutions have shown the presence of at least a single monoclonal antibody cell line against sheep EPO. Subsequent assays were confirming. Recognition of human EPO by the antibody was also noted in several experiments.

The monoclonal antibody has potential in the purification of EPO through the use of antibody-linked purification chromatography. The specificity of the monoclonal antibody to EPO may also allow for the study of EPO synthesis as well as the characterization of the EPO molecule.

#Fourth Award - General Motors ISEF
Honorable Mention - American Society for Microbiology

USE OF FRAGILE SITES ON PERIPHERAL BLOOD LYMPHOCYTES TO PREDICT SMALL CELL CARCINOMA OF THE LUNG

Pulido, Silvia M., Astronaut H.S., Titusville, FL 32796;
4005 Tiwa Ln., Titusville, FL 32796.

The malignant cells of most cancers in humans have a chromosomal defect. Specific chromosomal rearrangements appear to have clinical significance in many kinds of diseases, including X-linked mental retardation, leukemia, lymphoma, and carcinoma of the lung.

Fragile sites (regions of chromosomes very prone to breakage) may act as predisposition factors for certain chromosomal rearrangements in human neoplasias and some of them may represent oncogenic sites.

According to recent studies, chromosomal defects found in cancer cells may be displayed in chromosomes of peripheral blood cells as corresponding fragile sites. A specific chromosome defect associated with human small cell carcinoma (SCCL) is a partial deletion of the short arm of chromosome 3, (3(p14p23). It was hypothesized that the chromosomes of normal blood lymphocytes of people with SCCL have a fragile site in this region.

A chromosomal abnormality (deletion 3p) was found in at least one chromosome 3 in 10 cells of 10 patients with small cell lung cancer. This abnormality was not found in peripheral blood cells of 10 patients analyzed with adenocarcinoma of the lung and squamous cell carcinoma of the lung. One abnormality was found in one chromosome 3 of 100 cells analyzed from people with no malignancies.

The results of this experiment support the hypothesis that fragile sites are found in the (p14p23) region of the 3-chromosome of peripheral blood lymphocytes of patients with SCCL.

#First Award and Alternate to Operation Cherry Blossom - United States Army
Third Award - General Motors ISEF

FATAL FRUIT

Schott, Katherine L., Brookfield Central H.S., Brookfield, WI 53005
12709 W. Honey Lane, New Berlin, WI 53151

The objective of this experiment was to test the ability of citrus fruit, namely oranges, limes, lemons and grapefruit to act as a natural insecticide on field crickets; and to isolate the most toxic part of the citrus for this purpose. After this was accomplished, many other variables such as the amount of substance needed for death, time until death, length of citrus oil's effectiveness, and application procedures were also evaluated.

The size of the crickets, jars, and the amount of substance used in certain tests were kept uniformly constant. Also, a control group of crickets was maintained during testing.

Using a centrifuge to separate the various peel oils and liquid-gas chromatography to identify the substances in these oils, I was able to identify a light, clear oil in the epicarp as the most toxic part of the citrus. The primary constituant of this oil is a hydrocarbon called limonene. Out of the 3 application procedures, I found that placing this oil directly onto the cricket killed the insect the fastest. Also, a single drop from a 1.0cc syringe placed directly on the cricket, was sufficient to cause death in an average time of 40 seconds.

In all, the reactions of over 125 crickets when exposed to different sections of the citrus and citrus oils were documented.

#First Award - American Veterinary Medical Association
Third Award - General Motors ISEF

ELECTROPHORETIC TECHNIQUE FOR THE SPECIES IDENTIFICATION OF BLOOD

Gaskill, Newton J., Clearfield High School
Clearfield, Utah 84015
1132 W. 1800 N., Clinton, Utah 84015

A procedure was devised to quickly and accurately determine if a blood or tissue sample is of human origin. It involves the electrophoresis of the enzyme phosphoglucose isomerase (PGI). The numerous problems of using specific antibody-antigen reactions such as in the earlier immunologic tests, have been eliminated. The procedure uses small, easily handled cellulose acetate membranes and can be completed in less than one hour. It is based on the technique of James Wolfe, as published in the Journal of Wildlife Management.

To test the accuracy, over 20 different species of blood were compared to human blood. These included, ducks, cats, deer, sheep, monkeys, and apes. The blood samples were furnished from dead animals obtained by Utah Wildlife personnel and some specimens from the personnel of the Hogle Zoo in Salt Lake City. No live animals were used in the testing.

All the samples were easily differentiated from human blood except chimpanzee. The majority of the other species could also be distinguished from each other. This technique promises to be very beneficial to any people such as crime lab or coroner offices that need to identify blood.

DISCOVERY OF PROTEIN BOUND TO MITOCHONDRIAL DNA: ITS ROLE IN AGING AND CANCER

Shapira, Nathan A., Briarcliff H. S., Atlanta, GA 30329;
954 Liawen Court, N. E., Atlanta, GA 30329.

The possible role of mitochondria in aging and carcinogenesis has received little investigation. Sixty years ago, Otto Warburg discovered that most tumor cells convert more glucose to lactate than normal cells. This unexplained phenomenon indicates a change in the mitochondrial aerobic metabolism of these tumor cells. The hypothesis of this research is that changes in mitochondrial DNA affect gene expression and metabolism of mitochondria which could lead to alterations of the parent cell.

Mitochondria of animal cells were isolated by differential centrifugation. The DNA was purified by enzyme digestion, SDS-NaCl precipitation of protein, alcohol precipitation, and density gradient centrifugation. Hydrolyzing DNA released the bases which were separated by HPLC on a uBondapak C_{18} column in 0.1M triethylamine-phosphate buffer, pH 6.5, containing 3.75% ethanol and detected at 206 and 260 nm. Separated peaks were analyzed spectrophotometrically and by chemical analysis.

Mitochondrial DNA from bovine liver was found to contain unique modified bases, none of which were methylated bases. Instead these bases were modified by a bound protein with a unique amino acid analysis. Protein bound to mitochondrial DNA increased slightly in aging. HL-60 human promyelocytic leukemic cells in culture and human leukemia cells had more protein bound to mitochondrial DNA than liver mitochondria; but, when HL-60 cells were differentiated to nondividing cells, the amount of DNA-bound protein decreased. This indicates that mitochondria may utilize protein bound to DNA bases for regulation.

This protein could modify mitochondrial genes which in turn may affect nuclear genes involved in cell transformation. These findings may ultimately demonstrate a role of mitochondrial genes in aging and cancer.

#First Award - American Veterinary Medical Association
London International Youth Science Fortnight - United States Marine Corps
Third Award - General Motors ISEF
Fourth Award - American Chemical Society

#THE EFFECT OF PAINTS ON DROSOPHILA

Murphy, Delton, Renaissance High, Detroit, MI 48235
18088 Dwyer, Detroit, MI 48234

To determine the effects of paints known to contain carcinogenic as opposed to those that do not on the common drosophila; to determine if the carcinogenics can inflict a mutation on the drosophilas, and if this mutation can be passed down to future generations. I experimented with four popular paints supplied by DuPont Paint Company of Michigan. They were: Lucite, Centari, Imron, and the Primer paints. From each of the four paints used there were paints with/ without lead/ heavy metals present withich are the carcinogenic contaminates. I bred the drosophilas in a contaminated environment by placing a standard amount of paint in the media. I used a control for each test tube, breeding drosophilas that haven't been exposed and those that parents have been exposed in the normal environment. I carried out the drosophilas to three generations.

#Fourth Award - General Motors ISEF

ISOLATION AND PARTIAL CHARACTERIZATION OF DNA IN OIL PRODUCING ALGAE

Piester, Rob, Alice Robertson Jr. H.S., Muskogee, OK 74403
Rt. 6 Box 365, Muskogee, OK 74403

The purpose of this project was to focus on the prospects of controlling the rate of reproduction of an oil producing algae from which the oil could be harvested and used as a useful fuel alternative.

Early studies of algae and Escherichia Coli bacteria showed varied reproduction rates. The second phase of this investigation was initially to try and cleave the daily reproduction rate of the bacterial DNA and combine it with the algae DNA to create a faster oil producing algae. This researcher found that to do so, genetic maps which show the traits of both the algae and bacteria must be acquired to show where they must be cleaved. A genetic map of the bacterial DNA was easily acquired, but after thorough research a genetic map of the algae could not be found. The main thrust of this research became the development of a genetic map of the algae. After the isolation of algae DNA was achieved, partial characterization of DNA was established by use of a modified Maxam and Gilbert sequencing technique.

BIOCHEMICAL STUDIES IN VIVO AND IN VITRO ABOUT ANTI-TUMOR PROPERTIES OF ARGEMONE MEXICANA L. IN MUS-MUSCULUS

Meléndez, Adalberto, Rafael Rocca H.S., Naguabo, PR 00718
Bzn. 920 R.R. #3 Bo. Mariana, Naguabo, PR 00718

This investigation was aimed at determining the posible anticarcinogenous effects of Argemone mexicana L. in EAT. tumors. Mus-musculus males of the CD1 strain were used. Three extracts were prepared: Extract #1 was from roots in ethanol, Extract #2 was from leaves and stems in destilled water, and extract #3 was prepared from leaves and stems in ethanol. A first toxic test with the three extracts was conducted. It demonstrated that extract #3 was the most toxic; thus, it was eliminated. There were 6 experimental groups. Groups 2, 3 and 4 were inoculated with EAT tumors. Group #2 was the control group. Groups #3 and #4 were injected with extract #1 and extract #2 respectively. Group #1 was injected with saline solution, and groups #5 and #6 with extract #1 and extract #2 respectively. The test demonstrated that groups 3 and 4 exhibited 50 per cent remision. New tests are being conducted to obtain more significant remisions, The findings in this research would be of great advance in cancer investigations.

#CELLULASE: ENZYME FOR THE FUTURE

Than, Dzung Q., Clear Creek H.S., League City, TX 77573

10214 Sagegreen Dr., Houston, TX 77089

This project is the first step in a long experimental venture that is directed to the use of cellulases to convert plant biomass to fuel and food. To accomplish this ultimate objective, more must be known about the DNA controlled synthesis and characteristics of the enzyme cellulase. If the DNA coding for this enzyme can be identified and transferred to less exotic organisms capable of being grown by standard fermentation techniques, the enzyme may be able to be produced in commercially significant amounts.

The first step in attempting to identify such DNA has been taken in this project: cultures of Trichoderma viride have been grown and subjected to conditions expected to extract DNA. The DNA was cleaved by various restriction endonucleases and label with radioactive isotope P^{32}. These fragments were subjected to electrophoresis in polyacrylamide gels. Autoradiographs of these gels were examined for the occurrence of banding patterns. Ideally, one would like to obtain a type of reproducible fragments less than 50 kilo bases. Such fragments are capable of being cloned into vectors (eg. bacteriophages) for transfection into host systems (eg. bacteria). If the DNA containing the cellulase information is expressed in a given host, it should have the ability to utilize cellulose, or some suitable derivative, as its sole carbon source. This could then serve as a selection process for identifying commercially exploitable organisms. Reisolation of the DNA insert from vectors conferring this property will provide opportunities for basic research on the cellulase molecule itself and might lead to the design of enzymes with enhanced specificity, activity or resistance to inactivation.

#First Award - Gulf Oil Corporation
First Award - United States Air Force
Second Award - Patent and Trademark Office/U.S. Department of Commerce/

#GENETIC ENGINEERING, SABINA WU

CHOCTAWHATCHEE HIGH SCHOOL, FORT WALTON BEACH, FLORIDA 32548
108 LAKE LORRAINE CIRCLE, SHALIMAR, FLORIDA 32579

This project involves the transfer of genetic material between two strains of the bacterium Hemophilus influenzae. This organism is a nonencapsulated gram negative bacillus. The technique utilized is that of transformation, which is the process of transferring deoxyribonucleic acid (DNA) from one bacterial strain to another. Donor DNA was obtained from a strain of H. influenzae exhibiting resistance to the antibiotic streptomycin. This resistant trait is carried on extrachromasomal DNA known as plasmids. Extraction of the DNA was accomplished by lysis of the resistant cells in a solution containing detergents, chelating agents, and the digestive enzyme, pronase. Recipient cells, normally impermeable to DNA, must be made competent to accept the donor genetic material. This process involves the exposure of recipient cells to an anaerobic environment followed by dilution with a calcium chloride ($CaCl_2$) solution. After competency has been achieved the donor genetic material is combined with the competent recipient cells and incubated at 42C for 30 minutes. Following the uptake of DNA, the donor genetic material was incorporated into the host genome and the resistance to streptomycin was expressed.

#Alternate to Scholarship - Ohio State University

INTER-RELATIONSHIPS BETWEEN DIETARY FATTY ACIDS AND INDOMETHACIN: MAMMARY TUMOR GROWTH, PROSTAGLANDIN E_2 SYNTHESIS, AND IMMUNE RESPONSES

Cuong Viet Do, Northwest Classen High School, Oklahoma City, OK 73107
3217 Cashion Place, Oklahoma City, OK 73112

Studies were performed to determine the effects of dietary fat and indomethacin on: (a) Prostaglandin E_2 (PGE_2) production by splenic mononuclear cells; (b) growth of mammary tumors; (c) phagocytic activity of macrophages; and (d) cytotoxic activity of Natural Killer (NK) cells. Female, inbred, Wistar-Furth rats were fed semi-purified diets containing 2, 5, 10, or 20% stripped corn oil. Indomethacin was administered in drinking water to give final dosage of 2.5 to 3.0 mg indomethacin/kg body/day. Feeding of diets and treatment with indomethacin began when rats were weaned (21 days of age), and continued until time of sacrifice at 35 or 50 days of age. Rats were divided into two groups. The first group was injected with 5000 mammary tumor cells into the right inguinal lymph node area, and was used to determine the first two objectives of this paper, and other related parameters. The second group did not receive tumor cells and was used to determine the later two major objectives of this study. Results indicated: (a) fatty acid absorption was not influenced by indomethacin treatment; (b) linoleic concentrations in blood serum were significantly higher in rats fed high fat diets compared to low fat diets; (c) PGE_2 synthesis very significantly increased in untreated rats as dietary fat content increased; (d) indomethacin treatment very significantly abrogated PGE_2 production in all dietary levels; (e) tumor mass very significantly increased as dietary fat increased in untreated animals; (f) indomethacin very significantly reduced tumor mass in all dietary levels; (g) phagocytic activity of macrophages very significantly decreased with high fat diets; (h) indomethacin very significantly increased macrophage activity; (i) NK activity very significantly decreased as dietary fat content increased; and (j) NK activity very significantly increased with indomethacin treatment.

First Award - American Medical Association
First Award - General Motors ISEF
First Award - Ross Laboratories
First Award - United States Navy/Office of Naval Research
Alternate to Scholarship - Ohio State University

THE EFFECTS OF COENZYMES ON THE DORMANCY OF *AVENA FATUA* VARIETIES B AND G

Sorenson, Jodi K., Hallock H.S., Hallock, MN 56728
R.R.1, Hallock, MN 56728

Experiments were run on *Avena fatua* varieties b and g to test the relationship of coenzymes on breaking dormancy. A germination and volumetric oxidation test were run to determine how the coenzymes induced or inhibited the dormancy in *A. fatua*.

Three coenzymes--riboflavin, nicotinic acid (niacin), and pantothenic acid-- and a mixture of all three were used in various concentrations in both experiments. Volumeters were used to measure the oxidation of the *A. fatua* seeds. A comparative analysis of oxidation and germination was done when the most significant results occurred.

The results showed that pantothenic acid at 10^{-2} and the mixture of the vitamins at 10^{-2} and 10^{-4} concentrations increased the oxidation of *A. fatua* b, while riboflavin at 10^{-2} concentration and pantothenic acid at 10^{-4} concentration increased the oxidation of *A. fatua* g. The coenzymes that produced the highest germination in *A. fatua* b were the mixture at 10^{-2}, niacin at 10^{-2}, and riboflavin at 10^{-2} concentrations. The coenzymes producing the highest germination in *A. fatua* g were the mixture at 10^{-4}, pantothenic acid at 10^{-4}, and riboflavin at 10^{0} concentrations.

The results indicate that *A. fatua* dormancy is caused by an inhibitor at the coenzyme A level and the electron transport level of respiration, and that dormancy can be broken by the addition of coenzymes that tie up the inhibitor at these levels.

THE EFFECTS OF SO_2 ON CITRUS FREEZE RESISTANCE

Norris, Steven R., Cocoa Beach H.S., Cocoa Beach, FL
410 Brightwaters Drive, Cocoa Beach, FL 32931

The purpose of this project is to test the effects of sulfur dioxide on citrus plants' resistance to extremely low temperatures. As a result of a "freeze" or cold period, the plant cells go through a freeze-thaw process which destroys the cell walls, causing a thorough freezing of the cytoplasm which results in acute or chronic injury to the plant. This situation occurs naturally; however, an increase in SO_2 concentration could cause a drastic escalation of this problem.

The researcher will test the effects of the SO_2 by running a Thin Layer Chromatography test, a turbidity test, and an analysis using a spectrophotometer. The chromatography test is used to determine which of the normally occurring plant pigments are present at the time of the test. The turbidity test is used to determine the carbon dioxide consumption of the plant. Finally, the spectrophotometer analysis reveals the chlorophyll content in the leaves.

The researcher will subject the experimental and control groups to controlled conditions except for the presence of SO_2 and varied temperatures in the experimental group.

The TLC, turbidity, and spectrophotometer analyses will be run on both the control and experimental groups once everyday for a seven day period. The conditions will then be changed and the same procedures used. After the testing is completed, the researcher will compile the results from each day of testing to draw his conclusions.

#Second Award - General Motors ISEF

INHIBITION OF TRYPSIN, CHYMOTRYPSIN, AND HUMAN GRANULOCYTE ELASTASE BY LEECHES

Goldstein, Allan, Cheltenham H.S., Wyncote, PA 19095;
1421 Redwood Lane, Wyncote, PA 19095.

In all living organisms a balance exists between proteases and their inhibitors. In lower animals especially, such as leeches, the proteases are controlled by low molecular weight inhibitors rather than by existing as zymogens. Hirudo medicinalis, the only well-studied leech for protease inhibition studies, is known to have two trypsin inhibitors, a chymotrypsin-granulocyte elastase inhibitor, and an inhibitor of thrombin. The purpose of this study was to determine the protease inhibitor spectra of two commonly found leech species of North America and compare them to the spectrum of inhibitors known to exist in H. medicinalis, a leech not found in North America. Leech Type II,III (Haemopis sp.) was found to have a trypsin inhibitor and a chymotrypsin-granulocyte elastase inhibitor. Leech Type IV (Erpobdella sp.) showed a much smaller spectrum of inhibitors. This leech had one inhibitor active against both trypsin and chymotrypsin; however, there was no inhibition of granulocyte elastase. Neither of these two species had an inhibitor of thrombin. Clearly, this study shows that the inhibitor spectra differ among the three leech species compared. It also appears that the differences are more pronounced the further the taxonomical relation is between two species. There have been indications that proteases are involved in some disease states, especially elastase activity in emphysema development. We hope, therefore, that the study and isolation of natural inhibitors can be used clinically to stop the damage caused by uncontrolled proteolysis.

#Second Award - General Motors ISEF
Alternate to Scholarship - Ohio State University

AMES TEST FOR MUTAGENICITY

McCoy, Michael J., East High School, Salt Lake City, UT 84102
1407 Sigsbee Ave., Salt Lake City, UT 84103

The Ames test is a practical test for detection and classification of mutagens. This test involves the combination of Samonella typhimurium bacteria, S-9 liver extract and a buffer containing a substance to be tested for its mutagenicity. I conducted the test in four steps: 1. Test bacteria for histidine mutation (represents human cells) a. Spread bacteria on minimal "E" plate.

b. Put a crystal of biotin and crystal of histidine on each side of plate.

c. If bacteria is histidine minus bacteria will grow in middle of plate.

2. Make S-9 liver extract (represents human liver)
   a. A rat liver (10g.) washed in an equal volume of .15M KCL
   b. Minced with sterile pair of scissors
   c. Homogenated with a Potter-Elvejem apparatus
   d. The homogenate was centrifuged for 10 min. at (9000 x g)
3. The S-9 mix
   a. 0.3 ml of S-9 fraction
   b. .8mM $MgCl_2$
   c. 5mM glucose six phosphate
   d. 4mM sodium phosphate
4. The buffer
   a. 2ml of molten agar
   b. 0.1 ml. of a bacterial tester
   c. 0.1 ml. of compound to be tested
   d. 0.5 ml. of S-9 mix

The buffer is added to a minimal "E" plate. The plate is incubated for two days at 37°. If colonies of bacteria show up on the plates, this means the DNA in the bacteria has been reverted back to Histidine plus. This means the substance has mutated the DNA in a cell. It then has the potential of doing it in a human.

#"A PAGIF" AND "PAGE" STUDY OF HEMOGLOBIN, SERUM, AND PLASMA

TYLER, TONYA M., VICKSBURG HIGH SCHOOL, VICKSBURG, MS 39180
2106 BAKER STREET, VICKSBURG, MS 39180

"Pagif" or Polyacrylamide Gel Isoelectric Focusing is a type of electrophoresis that separates proteins according to their isoelectric points. A pH gradient is created when current is applied across ampholytes which come to rest at their own p^I. "Page" or Polyacryamide Gel Electrophoresis is a type of zone electrophoresis that exploits differences in molecular size and charge.

In most"Pagif" applications Ampholine, an expensive reagent, is used to establish the pH gradient. In my project a much cheaper reagent, bactopeptone, is evaluated as a substitute. Secondly, using bactopeptone generated "Pagif" a determination of the p^I of hemoglobin was made. Thirdly, observations were made noting the efficiency of "Pagif" and "Page" in resolving serum and plasma proteins.

Hemoglobin, serum, and plasma samples were obtained from several donors. "Pagif" samples were separated in 7.3% acrylamide and "Page" samples were separated in 15% upper gel acrylamide and 8% lower gel acrylamide. All samples were stained with 1% Coomassie Blue.

Experimentation supported the idea that bactopeptone acts as a sufficient ampholyte, but it is not as stable as Ampholine. The pH gradient achieved by bactopeptone required at least an hour to arrange itself was not maintained more than 2 hours. Using a "Pagif" technique in which bactopeptone generated the pH, the p^I of hemoglobin was cited to be 5.4-5.6 in resolving serum and plasma tentatively "Pagif" proved to be a better technique than "Page" proteins.

#Fourth Award - General Motors ISEF

ISOLATION, SEPARATION, AND IDENTIFICATION OF SYNTHETIC FOOD DYES

Shively, Randolph J., Marianna, FL 32446;
501 Broad St., Marianna, FL 32446.

Recent controversy dealing with food dyes led me to do my experiments, which dealt with the extraction of the dye from the food material, the preparation for thin-layer chromotography, and the identification of the dye used. The foods tested were soft drinks, fruit juices, candies, jellies, powdered drinks, gelatin desserts, breakfast cereals, and meats. The dyes which I found to be present were F.D. & C. Blue no. 1, Red no. 3, Red no. 40, Yellow no. 5, and Yellow no. 6.
After completing my study I have come to the conclusion that food dyes are prevalent in our everyday lives. While making our foods more attractive, they serve no practical purpose.

IDENTIFICATION OF BETA-ADRENERGIC RECEPTORS IN A NONFUSING MUSCLE CELL LINE

Young, Elizabeth A., Moore High School, Moore, OK 73160;
201 E. Ranchwood Circle, Oklahoma City, OK 73160.

R.P. Alhquist first classified alpha-adrenergic receptors and beta-adrenergic receptors on the basis of their degree of interaction with stimulating drugs, such as norepinephrine and isoproterenol. This study examined BC_3H-1 cells-- a clonal cell line closely resembling smooth muscle cells-- for the presence of beta-adrenergic receptors. Changes in the number of receptors per cell were monitered and found to increase in number with increasing age from plating. This varied from about 2,000 receptors per cell at 4 days to a plateau of about 7,300 receptors per cell from 8 to 12 days. Binding assays were conducted using ^{125}I-pindolol and specific binding of ^{125}I-pindolol to BC_3H-1 cells is present thus indicating the presence of beta-adrenergic receptors in BC_3H-1 cells.

#NEW AND IMPROVED EXPERIMENTS WITH PLANT PROTOPLASTS

Tokuno, Hajime A., L.V. Berkner H.S., Richardson, TX 75081;
913 Rutgers Dr., Richardson, TX 75081.

In four separate experiments concerned with the study of plant protoplasts, I have observed various results. Firstly, I found that cellulase is a more effective enzyme than driselase in the reduction of of the cell wall and the isolation of protoplasts causing the least damage to protoplasts. I have also seen that the mutagen EMS causes severe bloating of cell membranes and significant loss of viability. Thirdly, I have succeeded in fusing protoplasts by my simplified method using polyethylene glycol. Finally, I have studied the fusion of plant protoplasts with high voltage electrical currents. Experimental samples were derived from tobacco, collards, and euphorbia.

#Fourth Award - General Motors ISEF

#BIOCHEMICAL VARIATION IN BEANS, TOMATOES AND PEPPERS OBTAINED FROM PLANTS TREATED WITH GIBBERELLIC ACID AND CYCOCEL

Graham, Dorothy J., S.E.S.O. High School, Mayaguez, P. R. 00708;
Famboyan 186-P, Bellas Lomas, Mayaguez, P. R. 00708.

Tomato, bean and pepperplants were treated with gibberellic acid and CCC. The fruits were harvested and analyzed for moisture content, ash, ascorbic acid, protein, soluble carbohydrates, titrable acidity and carotene. These analyses were done to find out if the nutritional value of the plant products varied depending on the regulator applied. The changes induced as compared to the control (untreated plants) are summarized in the table below:

SAMPLE	REGULATOR	MOIST.	ASH	ASC. ACID	PROT.	SOL. CARB.	TIT. A.	CARO.
Tomato	Gibb. A.	N	+	+	-	+	+	+
Tomato	CCC	N	+	N	-	-	-	+
Bean	Gibb. A.	+	+	-	-	+	N.D.	-
Bean	CCC	+	+	-	-	-	N.D.	-
Pepper	Gibb. A.	-	+	-	-	-	N.D.	+
Pepper	CCC	-	-	-	-	-	N.D.	+

N = No change in Values + = Increase in Values Compa-ed to Control
- = Decrease in Values Compared to Control N.D. = Test Not Done

Gibberellic acid promoted growth while CCC retarded growth in all three species of plants. Plants treated with gibberellic acid seemed more frail, the leaves ahd a paler color as compared to the control, and wilted faster than the others. Plants treated with CCC were sturdier and had greener leaves. In all three species, the plants treated with gibberellic acid had much smaller and deformed fruits.

Plants treated with CCC may have great economic importance in places where droughts occur with frequency.

#Fourth Award - General Motors ISEF

THE ACTIVITY OF THE LIPOXYGENASE ENZYME IN LEGUME PLANTS

Awh, Edward S., Starkville H.S., Starkville, MS 39759;
212 Bridle Path, Starkville, MS 39759

There is an enzyme in legumes called lipoxygenase, the role of which is little understood. One plausible hypothesis submits that lipoxygenase (LOX) aids the germination process. The purpose of this study is to test this hypothesis.

Two different experiments using different varieties of legumes were conducted over a two year period. Legume plants --Bragg soybeans for the first year and California black-eyed peas for the second--were grown in the light and in the dark in controlled environments, and were harvested at different stages of germination and analyzed for lipoxygenase activity. In the second year study, a more refined analytical procedure was employed.

The findings of both the year one and year two experiments show that the level of lipoxygenase activity decreases steadily as germination progresses. Furthermore, the lipoxygenase activity in plants grown in the dark decreases much slower than that of the plants grown in the light. These results lend support to the hypothesis that lipoxygenase in legumes aids the germination process: the enzyme is more active and potentially supplies more energy at the initial stage of germination when there is no energy provided by photosynthesis; the enzyme activity decreases as the germination process progresses and the energy supplied by photosynthesis increases; greater enzyme activity is observed in plants grown in the dark and deprived of the energy source provided by photosynthesis.

#DEVELOPMENT AND EVALUATION OF A TECHNIQUE TO ASSAY HISTONES AND NON-HISTONE PROTEINS IN CHROMOSOMES AND ISOLATED NUCLEI

Paul Jackson, Los Alamos H. S., Los Alamos NM 87544
120 Sherwood, Los Alamos NM 87544

In recent years research has shown the significance of histones and other nuclear proteins in all areas of DNA replication, gene expression, and genetic disorders. Many techniques have been developed to prepare and analyze specific proteins and protein groups, but no one has ever developed a preparative technique to assay the nuclear proteins as a single group, at one time.

The purpose of this project is to develop a procedure whereby an entire nucleus or chromosome can be dissolved and its proteins separated by High Performance Liquid Chromatography. The procedure and successive identification of the unknown components (Nucleic Acids, Histones, and Non-histone Proteins). Eventually an efficient and practical method was obtained which satisfied the goals of the experiment. The procedure was then shown to be a viable method of nuclear protein differentiation. The procedure is being used to look at protein variation between chromosomes and interphase nuclei, something which has not been possible before.

This technique promises to be a valuable tool in future toxicology and cancer research. It will provide researchers with a system for preparing chromatin protein in such diverse areas as protein mutatins in cancer cells, protein differentiation between mamalian chromosome pairs, and protein modifications caused by heavy metals.

#First Award - General Motors ISEF
Honorable Mention - United States Army

A NATURAL INSECTICIDE

Spooner, Troy M., St. Maries H.S., St. Maries, ID 83861;
P.O. Box 138, St. Maries, ID 83861.

Most insecticides today are synthetic. Few natural insecticides exist, or they lack effectiveness. The purpose of this project is to extract and test a natural insecticide from Citrus sinensis epidermis, the orange peel.

Using both Drosophila melanogaster (fruit fly) and Musca domestica (house fly) as test organisms, experiments for maximum dilution effectiveness and prolonged ground life were conducted. The extract was diluted with distilled water, starting with one part extract to one part distilled water and concluding with a one part extract to ten parts distilled water, and sprayed by an atomizer for direct contact on test organisms. Thus the greatest dilution factor to maintain 100% kill in less than 5 minutes was determined to be 1 part to 6 parts for the fruit fly and 1 part to 4.3 parts for the house fly.

Insecticide ground life was determined by atomizing 10 c.c.'s of the highest effective dilution for both types of flies in a controlled space of 3.8 liters. Flies, in equal numbers, were then introduced into this space every 15 minutes until less than 100% kill was achieved. A ground life of three hours was thus determined for this natural insecticide.

These findings demonstrate, in part, that natural insecticides with good ground life and reasonable dilution factors are available and economically feasible.

#DNA, Cis-DDP, AND CANCER: A POSSIBLE CANCER MODEL SUGGESTED BY THE STUDY OF THE EFFECTS OF Cis-DDP ON THE STABILITY OF DNA BY USING INFRARED SPECTROSCOPY.

Nguyen, Bob (Hiep), Clovis West H.S., Fresno, CA 93710;
7377 N. Carruth., Fresno, CA 93711.

A few years ago, an intercalating drug, Cis-DDP, was discovered and used as an antitumor agent. However, its stereochemistry and its role in preventing cancer are yet fully understood. This investigation addresses this problem.

In this investigation, it is hypothesized that Cis-DDP prevents cancer by imparting a stability on DNA to prevent the DNA from undergoing conformational change (i.e. DNA conformates from a natural-occurring form, B-DNA, to an alternative stable precancerous form, Z-DNA). To test this hypothesis, inorganic salts (e.g. NaCl, KCl, and $MgCl_2$) are used to induce conformational change. Infrared spectroscopy is used to monitor the relative concentration of B-DNA being converted to an alternative form. Then by reacting DNA with inorganic salts and Cis-DDP, it is determined that the Cis-DDP prevents DNA from undergoing conformational change.

The data further suggest the following conclusion: 1) KCl rather traditionally NaCl, may be the best salt to use in studying DNA conformation; 2) short synthetic DNA strands behave in the same fashion as natural-occurring DNA; and 3) Infrared resonance frequency spectroscopy can be used as a effective tool for studying DNA conformation.

By better understanding the stereochemistry of Cis-DDP and its role in preventing cancer, a better and more efficient antitumor drug can be developed to fight cancer.

#First Award - Chemical Abstracts Service
Third Award - General Motors ISEF

TESTOSTERONE AND THE FEMALE RATTUS NORVEGICUS

Battalora, Jacqueline M., Victoria H.S.,Victoria, Tx 77901
206 Turtle Rock Dr., Victoria, Tx 77904

The effects of testosterone on 9 female rats divided into 3 groups of 3 rats each were studied. Group A were the Control rats; Group B were injected (7mg per body oz.) at age 6 weeks (repeated every 10 days); Group C were injected (7mg per body oz.) at age 4 months (approximate rat maturation) (repeated every 10 days). The experiment lasted 95 days. Weight, food consumption, and behavior were observed and recorded.

The findings revealed an increase in food consumption and body weight of Groups B and C. Behavior changes were noted in Group B. They were more aggressive, belligerent, and sexually aggressive.

After Euthanasia, the organs were measured and the muscles and ovaries were observed. Group B had the largest kidney, adrenal gland and heart but a smaller ovary. Group C had slightly larger organs than Group A, but a smaller ovary.

It was concluded that muscular development and size were enhanced and aggressiveness increased but the reproductive system was severly damaged by failure of proper ovarian growth and/or the presence of follicular atresia.

This experiment with female rats led me to conclude that female athletes using testosterone can sacrifice fertility and their genetic womanhood.

THE ENHANCEMENT OF METHANE GENERATION

Tully, Ricky D., Mt. Pleasant H.S., Mt. Pleasant, TX 75455
Route 1, Box 16A, Cookville, TX 75558

With the prices of all types of fuel soaring, an efficient system which produces methane gas from organic waste is highly desirable. The object of this research was to experiment with various materials to determine if their use in digesters would be an improvement over traditional methane generation techniques.

Erlenmeyer flasks were used as digesters. These flasks were connected to gas collection tubes and various materials were installed inside the experimental flasks. A 30% manure solution was used as the nutrient. In some cases the nutrient was circulated by a magnetic stirrer, while in other trials the experimental materials were moved inside the flask by a shaft connected to a small electric motor.

It was shown that polyester fabric can be used as a bacterial immobilizing agent and that a relative motion between the methanogenic bacteria and a beef waste nutrient solution can increase the initial rate of methane production by approximately 40%. It was also found that a bacterial toxin, hydrogen sulfide, could be removed from the nutrient solution through the use of copper metal. The resulting increase in all activity more than doubled the amount of methane produced by a control digester during a two day period.

#WHO'S ON THIRD? The Nucleotide Sequences

Robert E. Wray, III, Treadwell High School, Memphis, TN 38122
1011 Dillworth, Memphis, TN 38122

Of the three nucleotides which code for an amino acid, the first two bases exhibit the least variability. If the third base is a pyridimine, one amino acid is coded; if a purine, a different amino acid would result. Lehninger suggested the code for an amino acid was actually two-and-one-half bases. However, some amino acids formed regardless of the third base.

From the literature, I entered the nucleotide sequences of six E. coli genes into a microcomputer. The purposes were to determine: (1) If any significant preference of one base sequence existed over another. (2) if the same preferences existed in all six genes, and (3) if any relationships existed between the third base of one triplet and any base in the next triplet.

I developed several computer programs to evaluate the data and to determine the significance of a data set by using the Poisson distribution or the Chi-square test. From this I found that adenine had a key role. First, when the third base of a predominant code was a purine, it occurred with 70% to 90% frequency, but it was guanine rather than adenine. When a pyrimidine was the third base, cytosine and thymine shared equally, together coding 80% of the amino acids. Finally, rather than serving as a forecaster, the third base seemed to be an inhibitor. The most dramatic was cytosine, after which adenine was found only 9% of the time.

#Fourth Award - General Motors ISEF
Honorable Mention - United States Air Force

#SYNTHESIS AND METABOLISM OF PHOSPHOLIPIDS IN HUMAN Y79 RETINOBLASTOMA CELLS

Rosario, Raymond T., Central High School
Davenport, IA 52803
3128 Fernwood Avenue, Davenport, IA 52807

Specific characteristics of phospholipid metabolism in human Y79 retinoblastoma cells were investigated. Phospholipids are major constituents of the bilayer cellular membrane, its functions being essential to the cell's existence. The Y79 retinoblastoma is a human cell line that is derived from a tumor of the inner neural layers of the human retina. Retaining numerous neural characteristics, this cell line which continuously grows in suspension appears to be a potentially useful cellular model for the human retina and central nervous system. A basic experimental protocol was followed, utilizing radioactively labeled [^{3}H]serine and/or [^{14}C]ethanolamine substrates during incubations. Folch extraction and High Pressure Liquid Chromatography were the lipid separation procedures that were used. Approximately 50% of the [^{14}C]ethanolamine taken up in 48 h appears in the phospholipids, the remainder being present as phosphoethanolamine. The ethanolamine distribution pattern in lipids was 48% phospatidylethanolamine (PE), 44% ethanolamine plasmalogen (EP) and 5% phosphatidylcholine. [^{3}H]Serine also is recovered in PE and EP, but its conversion to ethanolamine occurs after it is incorporated into phosphatidylserine (PS). High concentrations of extracellular ethanolamine reduce the conversion of PS to PE by 40%. With [^{14}C] ethanolamine, both PE and EP reach a constant specific activity at comparable rates; whereas with [^{3}H]serine PE becomes saturated with radioactivity more rapidly than EP. These findings suggest that extracellular ethanolamine may be an important source of ethanolamine for PE and EP synthesis, even in cells that can synthesize PE from PS and thereby generate intracellular ethanolamine.

#First Award - Tissue Culture Association
Second Award - United States Air Force

#ANTICANCER ANTIBIOTIC AGENTS

Munshi, Imtiaz A., Bronx H.S. of Science, Bronx, NY 10468
444 East 20th Street, New York, NY 10009

Quinizarin (1,4-dihydroxyanthraquinone) an analogue of adriamycin, an anthracycline antibiotic, was used as a model to investigate and develop an understanding of the adriamycin membrane interaction. Fluorescence techniques were used to determine the binding of quinizarin to erythrocyte ghost membranes. It was found that the oxidized and reduced forms of quinizarin bound to the surface of erythrocyte ghosts. Polarization studies of oxidized quinizarin at varying temperatures indicated that the binding of oxidized quinizarin was a temperature dependent process. Emission and excitation spectral studies of both oxidized and reduced quinizarin suggested that an aqueous environment was needed for the reduction of quinizarin.

These findings suggest that the cell surface is a promising target of quinone-like antibiotic anticancer agents. Even though the quinone ring system is lipophillic it appears to be significantly soluble in water; indicating that molecules like quinizarin have strong potential to be chemotherapeutic agents, because they will be soluble in the blood.

#First Award - American Chemical Society
Third Award - General Motors ISEF

CHROMOSOMAL EXPRESSION OF CELL MEMBRANE PROTEINS IN CHINESE HAMSTER OVARY AND LEUKOCYTE HYBRID CELLS.

Zand, Dina J., Huron High School, Ann Arbor, MI 48105;
2098 Yorktown Dr., Ann Arbor, MI 48105

The human lymphocyte cell surface protein T8 is a recognized marker for a number of blood diseases such as leukemia. Linkage of T8 to a specific chromosome would be an important step in the ability to correlate these pathologies to genetic transmission. This study is the first to identify the linkage of human lymphocyte cell surface protein T8 to a gene located on human chromosome 11.

Linkage of the gene product to human chromosome 11 was accomplished using a series of Chinese Hamster Ovary (CHO)-leukocyte hybrid cells containing all of the CHO chromosomes and only human chromosome 11. These hybrid cells were treated with antibody specific to the T8 protein. Following that procedure the cell was treated with a fluorescein conjugated antibody specific to the T8 antibody. Control cells of human lymphocytes and CHO cells were treated in an identical manner. The presence of fluorescence on both the hybrid cells and human lymphocyte cells, but not the CHO cells, indicated the presence of the T8 protein on those cells containing human chromosome 11. Therefore, it was possible to conclude that human chromosome 11, found in both the hybrid and human lymphocyte cells, is linked to the gene that codes for protein T8.

Gene linkage studies are important both as the first step in chromosomal mapping and in determining the molecular basis of metabolic disease.

IMMOBILIZATION OF SALIVARY AMYLASE TO MAKE A BIOREACTOR

Hopkins, Christopher E., Bartlesville Mid-High School, Bartlesville, OK 74006; 3417 Willowood Drive, Bartlesville, OK 74006

Salivary amylase was immobilized by entrapment in an alginate gel and used in a reactor configuration to produce maltose from starch feed stock. Such immobilized enzyme reactors can be used to hydrolyze starch to produce corn syrups, prepare fermentation substrates, produce starch adhesives and make malt-dextran, a food thickener.

The optimal reaction conditions for salivary amylase to hydrolysed starch solution was determined. Starch was measured by the blue color produced upon addition of iodine to the reaction mixture. A colorimeter was constructed for accurate measurements.

A temperature of 45°C and a pH of 7.5 was optimal for the salivary amylase to hydrolyze the starch substrate. Higher temperatures caused enzyme denaturation. A variety of cross-linking divalent and trivalent salts were tested for their ability to form alginate gels from a solution of sodium alginate. Calcium and barium ions gave gels with the best elastic strength and firmness. Also these gels stayed insoluble for the longest period of time. By dialyzing the amylase against water at 4°C, I discovered that the amylase required chloride ion for full activity.

For the final formulation of immobilized amylase, calcium was selected as the cross-linking cation. The pH was maintained at pH 7.5 using 0.05M TRIS-chloride buffer which also supplied essential chloride ions to the entrapped amylase. When a dilute starch solution (250μg/ml) was perculated through a bed of enzyme-gel packed into a 50 ml plastic syringe barrel at a flow rate of 5 ml per minute, it was fully hydrolyzed to maltose.

THE ORIGIN OF LIFE

Smith, Michael J., Port Allegany H.S., Port Allegany, PA 16743
P.O. Box 316, Port Allegany, PA 16743

THE ORIGIN OF LIFE consists of a 50-page research paper and an experiment that was done by Sidney Fox at the University of Florida. The research paper lists and explains several theories and hypotheses. It also gives background information for each of the theories. The paper also explains several experiments and details them. The purpose of the paper is to give background information and a better understanding of what is being attempted through the experiment which is trying to illustrate how life on earth may have come about. It is a process of combining three separate amino acid mixtures into proteinoids through thermal polymerization. After allowing the proteinoids to cool, they are transferred to three labeled beakers and distilled water is added. This mixture is boiled until a colloidal solution is achieved. At this point, a drop of the solution is placed on a slide and covered by a cover slip. If the experiment is successful, then microspheres will be seen when examined under a microscope. A microsphere is a microscopic spherical droplet of about two microns. It is closely related to a cell membrane. The conclusion brought about by this experiment is that a living cell could be synthesized from simple inorganic matter.

#POLYURETHANE SOFT TISSUE ADHESIVES

Linford, Matthew R., Skyline High School, Salt Lake City, UT 84109
3385 So. 2770 E., Salt Lake City, UT 84109

Suturing, or the use of stitches, has been employed for many years as a method of closing wounds. However, the use of adhesives rather than sutures has great potential. Adhesives completely seal wounds, not allowing germs to enter the body, and can be made chemically to conform to the standards of the wound to be closed.

A polyurethane prepolymer -- the adhesive, was prepared from a diisocyanate and a triol. This was characterized by Infra-red Spectroscopy and then tested on skin samples obtained from the University of Utah Vivarium. The skin samples were primed with Ethylenediamene or pyridine before being adhered together with the prepolymer. Upon catalization by the primer, the prepolymer formed a three dimensional lattice -- the polymer, which held the skin samples together favorably, comparing well to the super-glue comparison used.

#First Award - American Medical Association
First Award - American Veterinary Medical Association
Second Award - American Intellectual Property Law Association

#POST-ABSORPTIVE IN VIVO ASSAYS

Stanton, Debbie, Spruce Creek High School, Port Orange, FL 32019
P.O. Box 4154, South Daytona, FL 32021

No abstract received.

#First Award - General Motors ISEF

THE HEAVY METAL DETOXIFICATION EFFECTS OF N-ACETYL CYSTEINE IN BOILOGICAL SYSTEMS

Francisco, Sharon, Burkburnett High School, Burkburnett, Texas 76354;
5511 Lucky Lane, Wichita Falls, Texas 76306

Currently, management of heavy metal poisoning is limited to two chelating agents, Dimercaprol and D-Penicillamine. Published studies have shown that Dimercaprol is relatively toxic and D-Penicillamine non-toxic, particularly when pure. Reports indicate that N-Acetyl Cysteine has been used successfully in the treatment of acetaminophen poisoning with few adverse reactions. Dimercaprol can only be administered intramuscularly, and D-Penicillamine, orally on an empty stomach. N-Acetyl Cysteine, on the other hand, may be administered in large quantities orally or intravenously, thus providing a fast delivery by any systematically accessible site.

The purpose of this clinical study is to determine whether N-Acetyl Cysteine can provide protection against methyl mercury chloride poisoning and to compare its effect with Dimercaprol and D-Penicillamine in methyl mercury chloride poisoning.

A determination of an acute lethal dose of methyl mercury chloride in laboratory rats was conducted. The final clinical studies have not been completed at this time.

I do hypothesize that the N-Acetyl Cysteine should successfully prolong survival time after a lethal dose of methyl mercury chloride. Due to its low toxicity and ability to be administered intravenously, N-Acetyl Cysteine should prove to be a superior treatment alternative.

BOTANY

THE EFFECTS OF 2,4-D ON SECOND GENERATION JIMSON WEED

Top, Shelli K., Mansfield H.S., Mansfield, MO 65704
Rt. 3, Box 241, Mansfield, MO 65704

This project was done to show the effects 2,4-D has on the reproductive systems of Datura Stramonium of the variety Tatula, commonly known as Jimson Weed or Thornapple. Because Jimson Weed can be harmful to both humans and animals and is also fairly common, the efficient control of these plants is important. The herbicide 2,4-D is widely used to control broad-leafed plants of this type.

This experiment covers two annual growing seasons, with plants from four experimentally treated plots. These included plants treated the first generation, those treated the second generation, those treated both generations and those untreated both generations.

Using plants treated the first generation only and totally untreated plants, the effects 2,4-D has on a Jimson Weed's reproductive system can be measured. The plants treated both generations can be used to find the projected effects of this herbicide on reproduction for the following generations.

PHASEOLUS VULGARIS AND VIGNA UNGUICULATA: HYBRIDS AND THEIR FILIAL GENERATIONS

Torres, Fernando, Colegio San Ignacio de Loyola, Rio Piedras, P.R.00924;
Calle 37-A #D-8, Colinas de Monte Carlo, Rio Piedras, P. R. 00924.

The plants Phaseolus vulgaris and Vigna unguiculata are both leguminous plants which are grown extensively in different parts of the World. This investigation attempts to create a hybrid through cross polination between P. vulgaris and U. unguiculata which may end having a higher production of seeds and/or a higher content of proteins and to compare the first, second and third filial generations with the parental stock. The seeds of Phaseolus vulgaris and Vigna unguiculata were planted, the plants corssed and the F1, F2 and F3 generations of the hybrids obtained. The production of seeds and protein content of the plants produced by each suceeding generation of seeds were compared. The comparisons revealed that the hybrids of P. vulgaris show a higher production of seeds when compared with the parental stock while the hybrids of U. unguiculata shows no difference with respect to the parental stock. The comparison of proteins showed a favorable change in the protein content of the hybrids of U. unguiculata, while the hybrids of P. vulgaris failed to show a large increase in protein content. A phenotypic comparison of the plants was carried out, including a comparison of the epidermis of the leaves. The comparison failed to reveal big differences between the parental stock and their hybrids, although slight differences were visible on the epidermis of the leaves of the plants.

#Fourth Award - General Motors ISEF

A CHEMOTAXONOMIC REPORT OF THE FAMILY LEGUMINOSAE USING PHYTOHEMAGGLUTININS.

Ortwerth, Michael, Fort Zumwalt H.S., O'Fallon, MO 63366;
1713 Pebblebrook Dr., O'Fallon, MO 63366.

In earlier studies done on plant lectins, it was determined that they had the property of agglutinating human erythrocytes. Special attention was paid to the Family Leguminosae; and even more attention was given to the subfamily Papilionoideae, sometimes known as Loteideae. In this subfamily, the number of lectins, or more precise phytohemagglutinins (PHAs), is tremendous.

The intent of this study was to discover whether any correlation exists between Legume phytohemagglutinin production and the taxonomy of the Family Leguminosae. Testing was done by regular blood typing methods using phytohemagglutinins obtained from ground seeds in place of antisera normally used. Seven of the seventeen Legumes tested gave positive PHA results. Of these seven, two had the characteristic of being specific to blood types A and AB. One hundred percent of the positive PHAs found were in the subfamily Papilionoideae. From this information, the following statements can be given: 1) Legume PHAs will agglutinate human red blood cells, 2) As studies move towards the subfamily Papilionoideae, the number of PHAs found increase, 3) In the subfamily Papilionoideae itself, a similar increase in PHAs occurs, and 4) From this information, a chemotaxonomic listing of the Legumes can indeed be made. Use of this research could be to refine the taxonomy of the important group of plants - the Legumes.

#Fourth Award - General Motors ISEF

THE EFFECT OF THE FLESHY LAYER OF *ZAMIA PUMILA* ON THE GERMINATION OF THREE ANGIOSPERMS AND *ZAMIA*

Carrión, Maribel, Eloísa Pascual High School, Caguas, P. R. 00625;
Arturo Más Z-G-4, Bairoa Park, Caguas, P. R. 00625.

A study on the effect of the extract of *Zamia pumila* on the germination process of several seeds was carried out. The seeds of *Copaifera officinalis* L., *Hardeum vulgaris* L., *Phaseolus vulgaris* L. and *Zamia pumila* L. were used. All the seeds were subjected to an extract made with the integumentary external fleshy layer of the *Zamia*. The extract was diluted in a liter of distilled water and applied to the plants every two days. Between 40 and 200 seeds were used for the experimental set-ups and the control. All the seeds received an incision in the intermediate layer except *Hordeum vulgare* L. The germination of each plant was observed for a period of 17 days and the roots were measured.

Based on the results, the germination time was one of three days for *Phaseolus vulgaris* L., of six days for *Copaifera officinalis* L., of four days for *Hordeum vulgare* L. and of sixteen days for *Zamia pumila* L. This shows that the extract of *Zamia* retards the germination of the seeds, with the exception of *Hordeum vulgare* L., which is induced to increase the number of roots. This study was repeated five times with the same results and analyzed using the T-Test and Chi-Square Test, comparing the control with the experimental set-up.

NEW FOOD SOURCES

Pennington, Barry D., St. Charles H.S., St. Charles, Mo. 63301;
2100 North River Rd., St. Charles, Mo. 63301.

It is predicted that our growth rate will be interrupted in the near future by an exhaustion of the available food supply. With this thought in mind, I decided to do a research project that would help find an alternate food source.

First, I did research on Chlorella vulgaris and Chlorella pyrenoidosa, both algae. I chose these plants because they grow very rapid in fresh water ponds. Second, I did research on mice to determine how much they eat per week and what they need in order to survive. Both algae contain proteins, vitamins, fats, and carbohydrates, all which are needed by mice and humans.

I raised two cultures of Chlorella vulgaris and two cultures of Chlorella pyrenoidosa. Both were raised in culture tubes with Knop's culture medium.

I set all four culture tubes in a rack, which I then placed under an incandescent light source. The culture tubes were kept about 74° F.

I examined each culture daily for growth. Weekly, I harvested the algae. The contents of each culture was pooled and centrifuged, the supernatant was discarded. The packed cells were dried and fed to the laboratory animals (mice) as a food supplement.

The reason for this project, was to find a new food source. I thought algae would be the best possible answer for a new food source. In conclusion, I found that both mice gained weight from eating the algae. So, it could possibly be that our next meal could come from algae.

ELECTRICITY'S EFFECT ON TROPISMS OF ANGIOSPERMS

Van Bladel, Kevin H., Santaluces H.S., Lantana, Fl. 33462
243 N.W. 28th Ave., Boynton Beach, Fl., 33435

In this project the author has tried to show the effect electricity has on the various tropisms of plants. Different experiments were made to prove these facts. Some of the experiments made by the author, using the Bryophyllum plant, have shown that electricity is able to change the geotropic curvatures in a plant. Shoots having electricity passed through them, after they were hung horizontally, would grow into an L-shape whereas control shoots hung in the same manner would grow into a U-shape. Other tests showed that chemotropism was affected by passing electricity through the stem of a plant. Further tests showed that water absorbtion, hydrotropism, was drastically altered by applying electricity through the plants tissues.

The significance of these experiments is the possible change in our agricultural procedures. Such things as the retardation of sap flow in cut flowers and vegetables to prolong their period of usefulness, and the reverse effect to hasten crop maturity are only a few of the possible new ways of expanding the agricultural production.

MANIPULATING PLANT GROWTH CONDITIONS

Fabijanski, Lisa A., Clear Spring High School, Clear Spring, MD 21722
Route 1, Box 56B, Big Pool, MD 21711

Today, with the extreme growth of the population, methods are being sought for mass agricultural production and for the development of strains of crops which are able to sustain the effects of adverse environmental conditions. The key to meeting this demand is the manipulation of such growth conditions, which will ultimately result in a more sucessful yield.

The purpose of this particular experiment was to determine how different exposures and types of light affect the germination of carrot seeds. Also, by growing tissue cultures, the process of rapid multiplicity of an organism could be examined.

The results of this experiment showed that shorter exposures of light after imbibition produce larger percentages of germinated seeds. The data also illustrates that germination occurs best after brief periods of imbibition. The first few minutes are the most critical in this process.

Different wavelengths of light have varied effects upon germination. When seeds were exposed to far-red light for 30 minutes after imbibition, 15.33% germinated. On the other hand, only 6.33% of the seeds germinated in the set which was not exposed to any light. Perhaps the use of far-red light exposures would be beneficial in the mass propation of certain plants.

Finally, ultraviolet light was beneficial when used in moderation One to three minutes of such exposure produced successful germination. However, any exposure beyond this inhibited growth.

In summary such research may provide answers in the search for more efficient mass propagation and production of selected strains.

CAN MICROWAVES SPEED UP NATURE?

Richards, David W., Tennessee Academy, Brownsville, TN 38012
Rt. 6 Box 122, Brownsville, TN 38012

The purpose of this project is to determine if exposing soybeans to electromagnetic radiation, more specifically microwaves, affects soybean germination and subsequent growth. For each of seven germination trials, I prepared four groups, A, B, C, and D, each containing 20 soybeans of the Bedford variety. Groups A, B, C, and D were exposed to microwaves for 0, 15, 30 and 45 seconds, respectively. All groups were then placed in a uniformly dark, moist area and observations were made every twelve hours, until one set completely germinated. Seeds from the first two sets were planted to observe growth.

The results showed Group C (30 sec.) germinated earliest. Of all the seeds that germinated in all trial sets, 16.71% came from Group A; 22.2% came from Group B; 33.41% came from Group C; and 27.68% came from Group D. The plants in Group D (45 sec.) are taller than those of the other groups in descending order (avg.): GroupD-562mm; Group C-546mm; Group B-521mm; and Group A-502mm.

I may conclude that exposing soybeans to microwaves for 30 seconds produces earlier germination than 0, 15, or 45-second exposure. Soybeans exposed to microwaves for 45 seconds grew faster than those exposed for 0, 15, or 30 seconds.

The data obtained can be reasonably applied to agriculture to increase soybean production. If germination can be hastened, the necessary time for plant maturation can be shortened.

THE EFFECTS OF POLAR MAGNETISM ON GERMINATION AND GROWTH RATE OF PLANTS

Victor Lamadrid, Catholic High School, New Iberia, LA 70560
402 Estate Drive, New Iberia, LA 70560

Through an investigation with the effects of long-term and short-term polar magnetism on four different types of seeds, I have concluded that germination and growth rates of plants are increased when the seeds are subjected to the south pole of a magnet. In contrast, these same rates were decreased when the seeds were subjected to the north pole of a magnet.

For my experiments, I placed the four types of seeds, all separated from each other, in individual envelopes. Magnets were then applied to the seeds so that they would be in contact with the seeds. After a specified number of days, I removed a certain number of seeds from both the north and south pole envelopes of each type of plant. I planted these seeds and compared their growth patterns to the control seeds which had no type of magnetism placed on them. Height and germination rates of all plants were then recorded. All environmental aspects of my experiment such as amount of water, light, and temperature were checked to make sure there weren't any discrepancies. Further studies have shown that these magnetic effects can be reversed if the magnetized seeds are replaced under the opposite side of the magnet for the same amount of time. The two effects seem to cancel each other out.

These surprising results were consistent throughout my entire experimental period. All four types of seeds showed the same general development pattern when they were planted.

#MICROBIOLOGICAL,STATISTICAL AND HISTOLOGICAL STUDY OF THE EFFECTS CAUSED BY SOME SPECIES OF COTTON SEED EXTRACTS OF THE GENUS GOSSYPIUM IN VARIOUS LIFE ORGANISMS

Rivera Medina,Santiago - Dr.Pila High School
Ponce PR 00731
Guayanilla road Ponce,PR 00731

The object of this investigation is to determine microbiological, statistical and histological effect caused by the extracts from different species of cotton seeds of the genus Gossypium over different types of bacterias and male mice of the species CD-1.The first phase consisted of a direct study of the cotton seeds of the genus Gossypium.Tests were carried out to determine the pigmentation,water,organic material and minerals.The purpose of the second phase is to determine the antibiotic potential of the cotton seed extracts.Tests were carried out "in vitro" with fourteen different bacterias,the sensibility tests were performed with inhibition discs of 1cm during 48 hours.The third phase consisted of the toxicological,histological and sensibility test of the extracts in masculine gametes of male mice of the species CD-1.The first pnase revealed that in the the three different cotton seeds were found the pigment chlorophyll A,this phase showed that the cotton seeds contain 13.3%water,5%minerals and 81.6% organic material.Seed A belongs Gossypium barbadense,seed B belongs Gossypium barbadense var.maritima watt.,seed C belongs Gossypium hirsutum.The second phase revealed that the extracts have antibiotic potential to inhibit the growth of B.cereus, B.subtilis and M.phlei.The variance analysis revealed there is a meaningful difference in the treatment of seed A in water and seed B in methanol with B.cereus,B.subtilis and M.phlei.The third phase revealed that the extract were not toxic when used in dose menor to .5ml.The histological study revealed that the cotton seed extracts do not make any harm to the cellular tissues of the liver and testicle.The cotton seed extracts from different seeds have anticonseptive effects in male mice of the species CD-1.

#Fourth Award - General Motors ISEF

THE VENUS FLYTRAP: A STUDY OF TRAP CLOSURE

Dunn, Thomas D., Jr., Holy Cross H.S., New Orleans, LA 70117; 4520 Marais St., New Orleans, LA 70117.

Over a century ago Charles Darwin called the Venus flytrap (Dionaea muscipula) "one of the most wonderful plants in the world", yet its trap closure mechanism is still widely misunderstood. This project contests the traditional hypothesis that trap closure is due to reduction in turgor pressure and loss of a solute, and supports newer research indicating the movement is due to cell expansion on the outside of the trap. Expansion of individual traps was measured, with significant swelling occurring in the outer epidermis of the lobe instead of the "hinge" or midrib. Rapid acid production is the presumptive explanation, due to experimentation confirming the higher trap acidity as compared to the rest of the leaf.

Under controlled conditions the traps were found to close by various combinations of trigger hair stimulation at set time intervals with different trap reactions. Other experiments involved studying closure with the traps treated with differing water temperatures. It was found that hot water caused the most rapid closure with cold water causing less response, followed by room temperature water causing no reaction.

#Second Award - General Motors ISEF

THE EFFECTS OF MAGNETISM ON PLANT GROWTH

Caruthers, Shelton D., Cedar Creek H.S., Ruston, LA 71270;
430 Forest Circle, Ruston, LA 71270

This exhibit presents a study of the effects of magnetism upon plant growth. The experimentation consisted of a comparison of the growth of sweet corn seeds exposed to a magnetic field to that of seeds not exposed. Photographs and precise measurements of the growth of both cotyledon and root systems were made on a quotidian basis for seven days. The experiments were repeated several times to establish the validity of the observed results. Exposed plants exhibited accelerated maturation and were as much as 54% larger than the control plants. The results are presented visually with photographs, photomicrographs, and graphs depicting the effects of magnetism upon the development of the plant. A written report presenting a literary search, collected test data, and bibliography accompanies the exhibit.

STUDY OF THE FLORA AT THE SAND DUNES OF "EL PASTILLO" BEACH IN ISABELA, P.R.

VERA MUÑIZ CARLOS J. - JUAN A. ARIZMENDI HIGH SCHOOL, QUEBRADILLAS, P.R.
MUÑOZ RIVERA ST. #163 QUEBRADILLAS, P.R. 00742

The main purpose of the study is to investigate if the climatic conditions such as environmental and soil temperature, relative humidity and wind velocity influence in the distribution of the flora of the sand dunes at "El Pastillo" beach in Isabela, P.R.

I found that existis a relation between wind velocity with the height of the plants that were no more bigger than 3 meters, and between the soil and enviromental temperature and relative humidity with the distribution of the flora, because in the areas, where the temperatures (soil and environment) were higher and the relative humidity lower; the distribution was not as big as it was in the areas where the temperatures (Soil and environment) were lower and relative humidity higher.

ELECTRONIC MONITORING OF GROWTH OF TOMATO PLANTS

Burgess, Timothy J., Santa Rita H.S., Tucson, AZ 85730;
7233 E. Fayette St., Tucson, AZ 85730.

The purpose of my experiment was to take accurate measurements of very small changes in stem diameter of tomato plants. This was achieved through the use of an electronic device known as a linear variable differential transformer (L.V.D.T.). These linear movement detectors were mounted on growing tomato plant stems with brackets, which I assisted in designing and eventually constructed. L.V.D.T.'s can detect the slightest movement with resolution down to 1×10^{-6} meters. A change in any particular unit of measurement may be calculated by using the gain of the L.V.D.T. This device is being tested for ultimate use in a water conservation system.

#Second Award - General Motors ISEF

THE EFFECTS OF SPECIFIC PLANT HORMONES UPON GEOTROPIC MOVEMENTS IN *Phaseolus* sp.

Nelson, Paul B., Andrews H.S., Andrews, Tx. 79714
1209 N.W. 12th Street, Andrews, Tx. 79714

The objective is to experimentally investigate the role of hormones in geotropism in *Phaseolus*.

To determine if the force of gravity is involved in the tropism, plants were placed on a 24-inch wheel and mounted in a vertical position. The wheel was rotated at 60 rpm for 24 hours. Specific hormones were placed on the inside and outside of the stem and the results were photographed. These experiments indicated that centrifugal force can be substituted for gravity and that hormones are involved in the response.

To determine the role that hormones play in the process of geotropism, time-lapse photography was used on horizontally placed *Phaseolus* seedlings. Various hormones of 500 and 5000 ppm concentrations were applied to the top and bottom sides of the stem. To determine if a synergistic relationship exists, combinations of hormones were applied.

The experiments indicated that gravity does not force the hormone to diffuse to the bottom side of the stem as previously thought. The tests seemed to indicate that the force of gravity alters the permeability of the cell membrane. This results in a change in the balance of chemicals within the cell, which may cause a synergistic action to take place. This synergistic action causes the cell to excrete an enzyme which softens the cell wall. The cell then swells through osmosis and elongation results.

MORPHOLOGICAL EFFECT OF CO_2 VARIATION ON CAPSICUM SP.

Dwivedy, Sunita, Quail Hollow JHS, Rt. 2, Pineville, NC 28134;
11222 Smoketree Ln., Pineville, NC 28134.

An experimental investigation was carried out on "The Morphological Effect of CO_2 Variation on *Capsicum sp.*" The study focused some light on the current concern of increased concentration of carbon dioxide in the atmosphere on vegetation. The experiment was carried out on the Sweet Hungarian Banana Pepper Plant. Beside the control group having normal atmospheric levels of CO_2, three groups (1 & 2 & 3) of equally sized 3-week old plants were transplanted into 16-oz. sized specimen jars and were subjected to additions of 1/672 moles, 1/336 moles and 1/168 moles of carbon dioxide respectively. At the end of the tenth day, several qualitative and quantitative morphological measurements were taken to study the effect of varied CO_2 in the different groups. Results revealed that in group 1, the plants had healthier, greener, and more lustrous appearances, higher weights, heights, and leaf numbers, and greater average leaf areas and stem diameters than the control group. Yet in groups 2 & 3 growth retrogressed. The morphological study showed that up to a certain level the CO_2, aids plant growth by increasing photosynthetic activity. However as the level of CO_2 increased, the beneficial effects were counteracted by the toxicity which caused the plant growth to retard. A preliminary experiment using higher CO_2 levels than those used in this experiment showed that plants die with excessive concentrations of CO_2. This study predicts the existence of a threshold level of CO_2 up to which plant growth is aided and beyond which lead to plant degradation and even death.

LETHAL YELLOWING IN THE SPECIES OTHER THAN PALM?

Tamayo, Richard, E., Harlingen H.S., Harlingen, TX 78550
Route 1 Box 253 B. Wilson Road, Harlingen, Texas 78550

The causal agent of Lethal Yellowing (LY) is a mycoplasma organism that resembles a bacterium without a rigid cell wall which is present in the phloem sieve elements. The mode of transmission is thought to be spread by a "leaf hopper." LY has been thought to only affect members of the palm species yet a Chinese tallow tree died of similar symptoms next to a row of infected palm trees. Three more trees died before the experiment began. Daily observations were made of the control group - Tree#1 (Infected), Tree#2 (Treatment) which was treated with oxytetracycline, and Tree#3 (Normal). Tree#1 left untreated, died; Tree#2 remained stable; and Tree#3 was never infected.

From daily observations support was found for transmission of LY. Tree#1 had a death of adventitious roots at the base of the trunk. A necrosis of developing inflorescences within the spathe also occured. Off coloration of foilage to brownish-yellow and dessication also resulted. The tree's ability to withstand disease was researched and found not to be a contributing factor. "Root-rot" did not kill the trees because of the small percentage found and because the well which excreted the salts was too far away to have any effect. Because Tree#1 most closely resembled the LY physical symtomology, the Chinese tallow trees were affected by some forms of yellows disease, possibly Lethal Yellowing.

CRYSTALLOGRAPHIC METHOD TO PREDICT COMPANION PLANT SYSTEMS

Juckes, Lisa M., Merewether High School, Newcastle, NSW 2292
13 Bershire Avenue, Merewether Heights, NSW 2291

Scepticism towards statements made claiming plant relationships could be determined by a crystallization test sparked off a piece of research investigating the validity of these statements, which had no data to support them, and also work into plant symbiosis.

It was found that crystallizations of plant extracts could be produced and were found to be reproducible and specific for different plants, with 'harmony' and 'disharmony' occurring in 'companion' and 'antagonist' mixtures. A possible method for analysis of crystallization mode was devised.

Field work showed some very interesting results regarding plant relationships, with strong evidence suggesting that companion and antagonist relationships do in fact exist.

When comparing the results of the field trials with their predicted results from crystallizations, large areas of agreement have been found and further work is in progress.

Possible future direction of research and applications lie in a variety of fields including pest control, commercial crop productions, allergy research, classification and computer analysis.

THE EFFECTS OF VARIOUS ECONOMICALLY SIGNIFICANT CHEMICALS ON THE ABSORPTION AND/OR TRANSPIRATION RATE OF *GLYCINE MAX*

Barnett, James L., Bay High School, Bay, AR 72411
Route 5, Box 443, Jonesboro, AR 72401

Soybeans are one of the major food crops grown in the world today. They are of great agricultural importance as well as having economical and nutritional importance. Chemicals which are economically and also environmentally important were used in the series of experiments conducted in this research.

The objectives in this experiment were to compare the absorption rate of soybeans after various economically significant chemicals were presented in the atmosphere; to determine which of the chemicals tested increased the absorption rate and note those which killed the soybeans; to determine which of the selected chemicals caused a decrease in absorption rates specifying those which resulted in death of the soybean; and to give an explanation for the reasons for altered absorption rates when some of the selected chemicals were present in the cloud atmosphere.

It can be concluded from this series of experiments that some chemicals which are economically and agriculturally important are detrimental to the soybean and that some of the chemicals tested on the soybeans caused death and greatly altered the absorption rate and the transpiration rate.

#SELF-SUPPRESSION IN PIGEONPEA AND ITS ALLELOPATHIC EFFECTS ON OTHER PLANTS

Pérez, Roberto, Colegio San José, San Germán, P.R. 00753
Urb. Porta Coeli B-8, San Germán, P.R. 00753

The pigeonpea, a tropical legume used as a grain, fresh peas, or forage, is popularly known for its ability to suppress weeds. Release of toxic metabolites by crop plants(allelopathy) is one weed suppression mechanism. In Puerto Rico, pigeonpeas decline in yield under continuous cultivation. Pigeonpea residues may affect yields on pigeonpeas and other crops. Self-inhibition of pigeonpeas may cause the decline of pigeonpeas in continuous cultures.

Beans grown with pigeonpea leaf residues show growth malformation. Transpiration and plant yield are severely reduced specially as residue concentrations increase. Bean roots are greatly inhibited by fresh leaves and non-volatile leaf fractions. Resin secretions were found on both sides of pigeonpea leaves. Water and hexane did not dissolve pigeonpea leaf secretions nor reduce leaf toxicity. Acetone and methanol easily dissolve pigeonpea leaf secretions and eliminated leaf toxicity. In 15 pigeonpea varieties no tolerance to toxicity was founded. Cucurbits were tolerant to pigeonpea leaf residues. Thus, pumpking, watermelon, and cucumber can be cropped with pigeonpea. Pigeonpea leaf residues were more toxic than those of corn or weed sorghum and slightly less toxic than velvetbean a plant used for weed suppression and carriaquillo(herb used medicinally).

Changes in the toxicity of pigeonpea residues were monitored in moist warm soil in vitro. Toxicity lasted for 7 weeks. Soil type affected toxicity. Toxicity was greatest in sand; least in a sand:clay:organic matter mixture; and intermediate in organic material or clay alone. Distillation, thin layer chromatography and column chromatography, were used to separate the toxic components. One TLC spot and two column fractions inhibited seeds of sorghum and tomato.

#Second Award - United States Air Force
Third Award - General Motors ISEF

THE INHIBITIVE ASPECTS OF COUMARIN IN MELILOTUS ALBA

Schnute, Mark E., North High School, Evansville, In 47711;
12817 U. S. Highway 41 N., Evansville, IN 47711.

My research deals with the ability of white sweet clover to inhibit the growth and germination of competitive plants. This includes the isolation of the chemical causing the inhibition as well as how the chemical produces this phenomenon.

First, dandelions were grown in between rows of white sweet clover where one group there was contact between the soil and the other a stained, wood barrier prevented water movement. Next, ground plant material was extracted with isobutyl alcohol for 24 hours. Components of the extract were isolated using paper chromatography which revealed the presence of coumarin, a chemical fairly unique to white sweet clover. Seeds of white sweet clover and soil were tested for the presence of coumarin, also. Using coumarin that was synthesized by the Perkin reaction, the ability of the chemical to inhibit germination of dandelion and radish seeds at varying concentrations was tested as well as the ability of substances to reverse this effect. Dandelions grown in contact with clover showed a 31% reduction in growth over the group with no soil contact as well as a 28% reduction in germination. When coumarin alone was used at concentrations of 5×10^{-4} molar to 10^{-6}, dandelion seed germination was reduced 33 to 25%. Concentrations above 10^{-3} M produced zero germination. Hydrogen sulfide, a proteinase activator, proved to be able to reverse the inhibitive effects.

White sweet clover apparently releases the chemical coumarin into the surrounding soil inhibiting germination of competitive seeds by bonding to the active sulfhydryl group in proteinase. White sweet clover and coumarin would be an excellent deterrent to weeds since it is less active on larger sized crop seeds.

#First Award - American Society of Agronomy
First Award - General Motors ISEF
Alternate to Scholarship - Ohio State University

3-INDOLEACETIC ACID AND ROOT NODULES

Wang, Chia-Ying, Richfield High School, Waco, TX 76710;
1704 Trinity Dr., Waco, TX 76710.

Nitrogen fixation in plants is dependent upon the symbiotic relationship between leguminous plants and Rhizobium bacteria. Nitrogen fixation takes place in the root nodules of these plants. The current understanding for such nodule formation is that the nodules result from the plant's reaction to infection by Rhizobium bacteria. 3-Indoleacetic acid (3-IAA) secreted by the bacteria could be the substance initiating the formation of nodules. In this experiment, 3-IAA was mixed with lanolin and applied to 1) specific areas on the roots of leguminous plants free of nodules and 2) existing nodules on some other plants. The nodules of other legumes were placed on agar slabs to allow stubstances present in the nodules to diffuse out into the agar. The agar slabs were placed on one side of decapitated coleoptiles of oat seedlings. Cell division will increase on that side if the auxin is present in the agar slab, and the plant will bend away from that side.

The following observations were made about the application of 3-IAA to roots: 1) no nodule formation, 2) no effect seen when applied to the side of a root, and 3) a long, feather-like growth extending from the tip of the root when applied to the root tip.

It is important that as much as possible be learned about legumes, Rhizobium bacteria, and nodules to understand better the important process of nitrogen fixation in plants.

#A LONG TERM STUDY OF THE EFFECTS OF DIFFERENT TYPES OF ELECTROMAGNETIC RADIATION ON GLYCINE G. MAX. WHEN THE SEEDS ARE TREATED PRIOR TO PLANTING

Elliott, Lloyd H., Franklin Co. H.S., Winchester, TN 37398
Route 2 Box 340, Estill Springs, TN 37330

The purpose of this study was to determine the effects of microwave, infrared, ultraviolet, and x-ray radiation on Glycine G. Max. (soybeans) when the seeds were treated prior to planting.

This study began by dividing the seeds into groups and exposing to a different type of electromagnetic radiation. After the process of germination had begun, the vegetative growth of each individual plant was monitored; thin layer chromatography was used to analyze the relative amounts of the pigments; water content, transpiration, and catalase determinations were performed weekly; the cytological structure of the plants was observed by periodically making balsam-mounted sections; and the rate of production was determined for each group.

Using statistical analyses, it was found that the microwave, ultraviolet, and x-ray radiation did not have a significant overall effect on the plants. In contrast, approximately fifty percent of the infrared seeds did not germinate, but those that did showed less vegetative growth and a greater rate of production than plants of the other groups. The infrared plants also exhibited a larger phloem region. Therefore, with controlled application, infrared radiation may possess the greatest possibility for a better plant.

#Scholarship - Ohio State University
Third Award - General Motors ISEF

A STUDY OF THE EFFECTS OF COMPANION PLANTING ON SEED GERMINATION AND EARLY GROWTH: A TWO-YEAR STUDY

Woodring, David Wesley
809 East Park Avenue, Fairmont, WV 26554
East Fairmont High School

The purpose is to study the effects of companion planting on seed germination and early growth. By planting eighteen different kinds of seeds together and observing them, in every combination of two, I determined that plants do affect each other. Through further research I found that caffeine and acetic acid can be isolated from coffee plants and decomposing straw respectively. In order to test only the allelopathic effects and to cut down on other variables, such as competition between the plants, I tested caffeine and acetic acid on pea plants.

The procedure has five phases. Water, caffeine and acetic acid were used in phases 1 - 3.

1. Test effects of each on mitosis of onion root tips.
2. Test effects of each on pea shoot and root growth for 6 days.
3. Test effects of each on the early growth of peas for 11 days.
4. Test growing plants for trace elements.
5. Measure the pH of the soil after growth.

Acetic acid discouraged any growth of peas. Decomposing straw may be harmful to crops.

Caffeine slowed down mitosis in onion root tips. It causes a deficiency in potassium that was abundant in the control plants. It decreases the growth of shoots in pea plants. It is not a growth stimulant.

THE EFFECT OF GAMMA RAYS ON MARIGOLDS

Allen, Jeffrey W., Ballard H.S., Louisville, KY 40222
2108 Glenview Avenue, Louisville, KY 40222

The main effect of gamma rays on marigolds is a change in the chemical make-up of a DNA molecule or a mutation. The research and experimentation proved that a mutation is likely after being submitted to gamma radiation. The experiment showed that stunted growth due to DNA changes is the most prominent mutational change. The research supported this theory, and showed that accelerated growth due to similar DNA changes is not uncommon. The marigold plant was chosen because it is quick to germinate and enjoys proficient growth. The variety of Calendula officinalis used was one with yellow blooms. This was a control used to determine if the radiation could alter the pigmentation in the blooms. The experiment showed that it did not. The experiment also showed that mutations occur mainly at 2000-3000 rads. However duplicate mutations occur at 100 rads. This supports the Target Theory, which basically states that mutations are a random occurrence in connection with radiation. The dosage rate of the gamma rays, which came from a Cobalt source, was 50-4000 rads. Control plants, which received no radiation exposure were also planted. The environmental conditions were duplicated for every plant. They include equal water, equal temperature, and equal time under artificial, incandescent lights.

#WATER HYACINTHS -- EFFECTS ON AGRICULTURAL POLLUTION, ENERGY PRODUCTION AND SOIL ENRICHMENT :

USING ANAEROBICALLY DIGESTED RESIDUE OF EICHHORNIA CRASSIPES FROM DIFFERENT NUTRIENT SOURCES AS SOIL SUPPLEMENTS

Renuart, Daniel R., Cardinal Gibbons H.S., Ft. Lauderdale, Fl. 33308
3310 N.E. 23 Avenue, Lighthouse Point, Florida 33064

In this project, controlled growth of water hyacinths was used to reduce nutrient loading from agricultural aquatic sources, processed to produce energy, and the digester residue recycled to return nutrients to the soil for germination and growth studies.

Purposes of this project were (1) to compare residue of anaerobically digested hyacinths with composted hyacinths for germination and growth of radishes, and (2) to determine whether nutrient levels of aquatic sources affect nutrient uptake, biomass increase, biogas production and quality, and nutrients of soils supplemented with processed hyacinths.

Phase I: Pontooned hyacinths from low-nutrient source were placed in varying nutrient sources to measure biomass increase. In additional experiments, effluents from those sources were measured for nutrient concentration changes in controls and in hyacinth-occupied tanks.

Phase II: Pontoon hyacinths were processed for aerobic composting or anaerobic digestion. Digester samples were measured for VFA, and the biogas analysed for composition.

Phase III: Soil supplements of composted hyacinths, digester residue and residue augmented with digester effluents were analysed for N,P,K. 1100 radish seeds were observed for germination in 11 soil variables and controls. 275 mature roots were measured.

A relationship existed between nutrient concentration in aquatic source with nutrient uptake and hyacinth biomass increase. A greater percent of CH_4 was present in digesters from high-nutrient sources. Radishes germinated more rapidly and roots grew 22 - 118 % larger in augmented residue than in composted media. T-tests and Chi-square indicated significance.

#First Award - U.S. Department of Energy
Third Award - General Motors ISEF

THE CORRELATION OF SEED DENSITY TO GERMINATION

Helbig, Christina M.
Cass Technical High School, Detroit, MI 48201
1351 Joliet St., Detroit, MI 48207

The purpose of this project was to determine if there was a correlation between seed density and germination rate and occurance. The mass and volume were measured for fifty of each of the following: lima beans, pinto beans, kidney beans, and black-eyed peas. Their density was calculated and those with similar density were divided into ranges of equal size. They were placed between wet paper toweling for fourteen days and those which germinated were recorded three times each day. Graphs of the number and percentage of seeds germinated each day were made. The lima bean seeds were removed from the experiment due to excessive fungal growths. All of the pinto beans seeds germinated, twenty-three out of fifty kidney bean seeds germinated. The seeds appeared to have germinated in a random fashion and the percentage germinated in each density range also appeared to be random. Based on these data there was no correlation between seed density and the germination rate or occurrence.

#THE EFFECT OF ERGOSTEROL BIOSYNTHESIS INHIBITING FUNGICIDES ON THE GERMINATION OF APPLE POLLEN

Cruttenden, Lisa, Barry H.S., Barry, IL. 62312;
Frankden Orchards, Barry, IL 62312.

Previous studies have shown that in general, fungicides interfere with the germination process of apple pollen. A new group of fungicides acting as ergosterol biosynthesis inhibitors have just been released (some to be released soon) for use by the public. It was the object of this research to prove that they would interfere with apple pollen germination. Germination medium and fungicide were mixed to produce the desired rate. This was placed on depression slides, inoculated with viable apple pollen, and allowed to germinate for twelve hours. The slides were then observed under a viewing microscope, and germination inhibition and pollen-tube growth were calculated by percentage of controls. All ergosterol biosynthesis inhibiting fungicides interfered with the germination process of pollen, although each interfered to a different degree.

#First Award - American Phytopathological Society
First Award - United States Navy/Office of Naval Research
Scholarship - Ohio State University
Second Award - General Motors ISEF
Honorable Mention - United States Army

EXTRACTION AND ISOLATION OF REPELLANT SUBSTANCES FROM PLANT SOURCES

Call, Stephanie A., Oakland Mills H.S., Columbia, MD 21045
9302 Old Line Dr., Columbia, MD 21045

No abstract received.

#First Award - General Motors ISEF
Honorable Mention - United States Air Force

#TEST FOR NATURAL RESISTANCE OF LIVE OAK TREES TO THE VASCULAR OAK WILT PATHOGEN CERATOCYSTIS FAGACEARUM.

Hausler, Cara J., MacArthur High School, San Antonio, TX 78233; 15319 Pebble Height, San Antonio, TX 78232

Oak wilt, a serious vascular fungal disease, threatens thousands of acres of live oaks in Texas. There is no cure for oak wilt nor an effective means for checking its spread. The demise of the live oaks will result in incalculable losses to farmers, ranchers, sportsmen and homeowners of Texas. The purpose of this project was twofold: (1) to isolate Ceratocystis fagacearum from diseased live oak trees and prove it the causative pathogen, and (2) to determine if the live oak (Quercus virginiana Mill.) has natural resistance to oak wilt. Ceratocystis fagacearum was successfully isolated from diseased live oak trees and proven the causative pathogen using the modified four step procedure for proof of pathogenicity as proposed by Robert Koch. During the second stage of the project, a total of 225 experimental seedlings, germinated and grown from acorns gathered from fifteen live oak trees located on three sites in central Texas, were inoculated in three trials with a dilute solution of Ceratocystis. Seventy-five control seedlings were likewise inoculated with sterile water. Active symptoms of oak wilt appeared in seedlings in all three trials. No symptoms appeared in the control seedlings. Reisolation of Ceratocystis from infected seedlings was successful, proving it the causal agent of the disease. Statistical analysis of the data revealed that live oak seedlings are not naturally resistant to oak wilt, that no relationship exists between the site of the parent tree and the seedling's resistance to oak wilt, and that there is no relationship between the age of the seedlings at the time of inoculation and their resistance to oak wilt.

#Second Award - American Phytopathological Society

THE EFFECTS OF $(NH_2)_2CO$ ON RHIZOBIA ROOT NODULE DEVELOPMENT

Hendel, Elizabeth L., Caledonia H.S., Caledonia, MN 55921
R. R. 1, Box 190, Caledonia, MN 55921

The purpose of this experiment was to determine how applied urea affects the development of rhizobia root nodules on a legume. The rhizobia live symbiotically on leguminous plant roots and fix atmospheric nitrogen. Urea is an unavailable nitrogen source for the genus.

Varied amounts of dissolved urea were applied to Hodgson 78 brand soybeans when planted. The amounts of urea tested were equivalent to 0, 15, 30, 60, 80, 100, and 120 pounds per acre. Light, temperature, humidity, and water were controlled and identical for all pots throughout the experiment. Observations were made and data was recorded for growth and development of all test plants.

After seven weeks the roots were carefully rinsed and nodules greater than or equal to .7mm were counted, dried, and weighed.

The results of this experiment indicate that, as the amount of urea is increased, size and total weight of rhizobia root nodules is decreased. However, these applications have no effect on the number of nodules or the height of the soybean plant.

#Does Silicon Alter The Cell Wall Elastic Properties of Loblolly Pine?

Newton, Courtney C., Bryan High School, Bryan, Texas 77802; 502 College View St., Bryan, Texas 77801

It has been suggested that silicon (Si) deposits in plant cells provide mechanical reinforcement, allowing them to withstand high pressures. Since Si appears to be associated with cell walls, it was hypothesized that Si would decrease cell wall elasticity. This hypothesis was tested by: (1) administering Na_2SiO_3 (70mg/L) to soil in pots containing Pinus taeda seedlings; and (2) subjecting the shoots and roots to 3 bar increments of pressure (P) in a pressure-bomb and measuring the water volume (V_e) exuded. A plot of 1/P vs. the volume of exudate (V_e) produced a linear relationship expressed by the formula: $1/P=-V_e/nRT+V_o/nRT$ (Tyree and Hammel 1972). Extrapolation of the straight-line to the 1/P axis, where $V_e=0$, provided a means of determining the osmotic potential, ψ_s; ($1/P=V_o/nRT=1/\psi_s$). Shoots treated with Si had an ψ_s of -16.4 bars, while control-shoot ψ_s was -4.9 bars. Roots treated with Si had an ψ_s of -13.3 bars, with control roots having a value -8.3 bars. The lowered ψ_s in both shoots and roots treated with Na_2SiO_3 was attributed to the absorption of the salt by the seedlings.

The bulk modulus of elasticity (ε) was determined using the formula: $\varepsilon = \Delta P/\Delta V_e \cdot V_w$ (V_w = Fresh weight - Dry weight). A low value of ε indicates a plant tissue with more elasticity. A plot of P vs. V_e produced a linear relationship with a slope of $\Delta P/\Delta V_e$. Shoots treated with Si had an ε value of 147.0 bars while control shoots had a value of 95.3 bars. Roots treated with Si had an ε value of 108.9 bars with control roots having a value of 61.4 bars. It was concluded that tissues of Si-treated plants were less elastic than control tissues.

These data suggest that Si is impregnated within the cell wall and this decreases the elasticity of the plant tissue. Si may provide drought resistance via modification of elasticity.

#Fourth Award - General Motors ISEF

EXPLORING THE NITROGEN-POTASH RELATIONSHIP IN CORN

Laible, Philip D., Mid-County Jr.-Sr. High School, Varna, Illinois, 61375; R.R.#1, Magnolia, Il. 61336.

The purpose of my project is to discover what the most economical rate of nitrogen is for corn and to see if a higher rate of potash will effect the results.

I took a nine acre plot, prepared the soil, applied fertilizer before planting with the analysis of 40 lbs. nitrogen-100 lbs. potash, and 120 lbs. potassium to the whole plot, and also applied to half of the plot 120 lbs. of additional potash. The applying of herbicides, planting of the corn, and cultivating were the same throughout the plot. Then, anhydrous ammonia was applied at six different rates. There were two sets of these rates. One set was on the half of the field with 120 lbs. of potash and the other set was on the half of the field with 240 lbs. of potash (see field map). The corn was harvested, weighed, and the moisture content was tested.

Conclusions: Considering corn at $3.40/bu., anhydrous ammonia at $215/ton, and potash at $150/ton, it is economical to apply a rate of nitrogen at 240 lbs. with 240 lbs. of potash. It is most important to apply a rate of nitrogen at 120 lbs. or more. The half of the field with 240 lbs. of potash returned more money when 120 lbs. of nitrogen were applied than the half with 120 lbs. of potash. Also, the higher the nitrogen application, the lower the moisture content was at harvest.

#SEAGRASS LEAVES: AN ALTERNATIVE TO COMMERCIAL FERTILIZERS ON COASTAL POOR SOILS IN TROPICAL ISLANDS.

Lucca, Ana E. - Holy Rosary School - Yauco, P. R. 00768
Box 533, Guayanilla, P. R. 00656

In view of the increasing costs of commercial fertilizers and in view of the poor coastal soil conditions of tropical islands, a study was conducted to determine the value of highly productive seagrass leaves (Thalassia testudinum) (KONIG) as a nutrient source for cultures of corn, green pepper, and tomatoes. The experiments consisted in growing these plants from seeds placed in containers containing gravel as control, and in containers with different proportions of dried, grounded seagrass leaves with gravel. Plants grown in gravel alone were used to simulate soils with little or none organic matter content. In addition the same plants were grown on sterile soil with or without seagrass litter as fertilizers. All plants grown with seagrass litter grew significantly more healthier, and with no signs of chlarosis than control plants. It was also determined that the tropical seagras Thalassia testudinum grows relatively fast (23 - 25 cm/2 weeks) suggesting that it could be harvested in the future for growing such products in underdeveloped islands with inadequate coastal soils. Sea grass leaves are rich in nutrients, help preserve soil humidity, and calcareous epiphtes on them help to stabilize the PH of the soil by acting as buffers

#First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent Office Society

THE DISTRIBUTION OF DEAD WOOD MASS IN A TROPICAL FOREST

Caro-Cadilla, Angel M., University of Puerto Rico, M.S.
Rio Piedras, Puerto Rico 00931
R-11, 20th St., Ciudad Universitaria, Trujillo Alto,
Puerto Rico 00760

Most of the biomass and nutrients in tropical forests are stored in wood. Many studies have documented wood production but not its decomposition. However, wood decomposition determines the velocity at which its biomass and nutrients are recycled in the forest. This study is the first step to determine the rate of wood decomposition in a palm forest at the "El Yunque" Rain forest. Four questions were addressed: What is the amount of dead wood in the forest? How is the dead wood distributed? Which are their decomposition stages? How is the dead wood distributed among the different stages of decomposition? The study area is a 100m X 40m plot and was divided in 40 sub-plots of $100m^2$. Dead wood in each sub-plot was mapped for future reference. The length and diameter of each piece of dead wood was measured to determined its volume, and classified in one of five categories according to its stage of decomposition. Known volumes of samples from each decomposition category were weighted to obtain their density and and to convert volume estimates to dry weight. Dead wood in the forest was 33.5 m^3/ ha distributed as follows: 69.7%, 3.3% and 27% in lying dead, stumps, and standing respectively dead. Advanced stages of decomposition were predominat. This suggests that the production of dead wood in this forest is low or that wood decays rapidly. Apparently, there is a significant amount of wood decomposition of before it falls. There was more dead wood in steep areas compared to flat ones, suggesting an higher rate of tree mortality in the sloped areas. More studies on the dynamics of dead wood are needed to determine its role in tropical forest.

PHYSIOLOGICAL EFFECTS OF CHEMICAL SUBSTANCES PRESENT IN IPOMOEA tiliacea IPOMOEA polyanthes, PASSIFLORA edulis, AND SECHIUM edule IN PHASEOLUS, vulgaris PLANT S

Noraida Carrasquillo, Luis H. Veronne H. S-Canóvanas, Puerto Rico 00629
Buzón 498-B Carr. 185 Barrio Cedros, Carolina, P. R. 00630

The purpose of this study is to observe if physiological effects in the Phaseolus vulgaris is produced by chemical substances in plants mentioned in the title. If substances extracted from these plants produce physiological effects, the Phaseoulus vulgaris plants will have a physiological development different from control group.

Reed's apex of plants is put in 95% ethylic alcohol to extract substances. Substances from plants mentioned in the title are obtained separately and 5 grams of lanolin is added per each 100 ml. of alcohol solution to absorb dissolved substances.

The lanolin containing the extracted substances is put over the stems of Phaseolus vulgaris plants. The procedure is repeated using 100% alcohol.

A dough prepare with lanolin and ethylic alcohol is applied to the stems to determine itseffect.

The application to the stems of the dough prepare with the extracted substances and 95% alcohol inhibits growth, produces bulky stems group while the control group had a faster growing, enlargement of the stem diameter, variation in the number and size of grains pods and flowers.

Ethylic alcohol killed the plant, pure lanolin produces fruits without seeds and a variation in their development.

I conclude that in the plants mentioned in the title we can find substances that can be vegetable hormones ad auxin, gibberellin, cytokinins and ethylene.

BROOM SNAKEWEED "DISARMED"

Renee Armstrong, Ft. Sumner High School, Ft. Sumner NM 88119
Rt. 1 Box 107, Ft. Sumner NM 88119

Can broom snakeweed be chemically, mechanically, or naturally disarmed of its allelopathic effects?

Chemical disarmament was attempted by treating the seeds with liquid and powder Polyethylene Glycol. The degree of success depended upon the seed type and method of treatment. Sideoats grama germination increased by 18% with powder treatment in the leaf solution. Galleta germination increased by 21% with the liquid treatment in the bloom solution. Radicle growth and color improved in nearly all treated seeds tested.

Mechanical treatment of burning broom snakeweed brought surprising results. A 2.5 ml ash solution showed a slight restriction. A 20 ml ash solution reduced germination 71%. The pH was adjusted, but germination still decreased 53%.

Natural disarmament was attempted by locating seeds not affected by broomweed's allelopathic agents. Blue grama was the least affected, with 83% germination in leaf solutions and 68% in the bloom solutions; sideoats grama had a 57% germination in the leaf and 70% in the bloom; and galleta had 60% in the leaf and 78% in the bloom. Buffalograss, alkali sacaton, sand dropseed, and little bluestem showed poor results.

"Mother Nature" provided the most unusual method of disarming broom snakeweed--a cool season drought. All leaf solutions of the stressed broom snakeweed, germination was 10% higher than in nonstressed plant solutions.

Broom snakeweed lost some of these battles, but is still winning the war for rangeland.

#ROOTS - THE DYNAMIC BALANCE

Deanna M. Sanchez, Grants High School, Grants NM 87020
4910 Ice Caves Rd., Grants NM 87020

Climatic and edaphic factors contribute to the success or failure of overall stabilization of slopes. Therefore, the root structures of Fourwing saltbush, Atriplex canescens; Blue grama grass, Bouteloua gracilis; and Alkali sacaton, Sporabolus airoides were studied in their relationships to slope stabilization. Root lengths were measured; and this information was applied to the root elongation rate when shale and aggregate were used for slope rehabilitation.

When plants were grown from seeds on a test slope it was concluded that subsurface terraces should be located four feet underground; the layer of shale should be 1½ inches thick; and a course aggregate should be used. Lateral branching root systems such as those found in Atriplex caescens are beneficial to slope reclamation as roots can reach the aggregate and moisture levels.

Because the reclamation of slopes presents serious problems concerning water retention, surface slides, and sheet and rill erosion, new methods of slope stabilization must be improved and perfected. Through research and experimentation the use of subsurface terraces and shale will become useful in all aspects of life. This method can become normal procedure for the stabilization of mine spoils, highway easements, and landscapes.

#First Award and Alternate to London International Youth Science Fortnight - United States Army
Third Award - General Motors ISEF

#STUDY OF THE EFFECT OF PLANT EXTRACTS OF THE FAMILY SOLANACEAE IN TWENTY SPECIES OF HARMFUL INSECTS.

Cruz, Pascual, Lola R. de Tio High School, San Germán, P. R. 00753; Ruta 874, Bzn. 363-A, San Germán, P. R. 00753.

This investigation attempts to find an insecticide that will not pollute waters and will not affect plants. It also aims to find a use for members of the Solanaceae family which are considered as weeds. The family was selected since our folklore indicates they are used to kill insects. Twenty species ahve been used.

Water extracts have been tested against ten species of harmful insects with the first 7 plants. Extracts were made of flowers, roots and leaves. Extracts were applied with a spray bottle to ten insects of each species. Observations were made from ten to sixteen seconds, two minutes, 1/2 hour, 1, 4, 12, and 24 hours. The least resistant insect was Selenothrips rubrocinctus. Resistant insects in water were Phyllophaga vandinei and Periplaneta americana.

Methanol extracts of 20 species of plants were applied to all 20 species of insects. Most effective plants were: S. torvum (fruit), D. suaveolens (flower), D. metel (fruit), L. esculentum (fruit and leaf) and D. stramonium (fruit). Phyllophaga vandinei was the resistant insect, 30 minutes being needed for its demise.

Toxicity effect of plants was checked against L. reticulatus and A. aegypti using different dilutions of extracts. Distillation of S. torvum showed fraction #13 killed T. confusum in 14 minutes and fraction #14 in 6 minutes.

Methanol extracts were separated via TLC using a 5:1 mixture of chloroform and methanol as solvent. Leaf of S. torvum showed 6 spots. Spots tested against S. rubrocinctus showed #2 with biological activity killing insect in 2.5 minutes. Spot #5 showed some activity.

Separation of active component is in progress using column chromatography. Histological cuts showed concentration of alkaloids in cells of leaves.

#Honorable Mention - Eastman Kodak Company

#THE COMBINED EFFECTS OF PHOTOTROPISM AND GEOTROPISM ON SUNFLOWER AND CORN SEEDLINGS

Hamilton, Deborah K., Garden City High School, Garden City, KS 67846
1906 Koster Drive, Garden City, KS 67846

This study was conducted to determine the combined effects of phototropism and geotropism on plants. Phototropism is the response of a plant to light, and geotropism is the response of a plant to gravity. Shoots are positively phototropic, growing toward light, and roots negatively phototropic, growing away from light. Roots are positively geotropic, growing toward the force of gravity, and shoots, negatively geotropic, growing away from the force of gravity. In this experiment, light and gravity were both affecting the plant from below. All the above principles cannot hold true in this case. The purpose of this experiment is to see what happens when light and gravity are both affecting the plant from below.

Corn and sunflower seeds were germinated in Petri dishes using the wet towel method. The seedlings were allowed to grow vertically in the dark. Then the plates were turned horizontal. One group was placed with light coming only from below. The other group in total darkness. The shoots of both the corn and sunflower seedlings curved upward, away from light and gravity. The roots grew downward toward light and the force of gravity. The response of the shoots away from light suggests that gravity has a more powerful effect on plants than light.

#Fourth Award - General Motors ISEF

#AN ECOLOGICAL, PHYSIOLOGICAL, BIOCHEMICAL AND POSSIBLE ALLELOPATHIC STUDY OF MISTLETOE IN PUERTO RICO WITH EMPHASIS ON ITS BIOLOGICAL CONTROL

Torres, José A., Lola R. de Tió H.S., San Germán, P.R. 00753;
29 Luna St., San Germán, P. R. 00753.

Mistletoe represent a group of hemiparasitic plants not too well known among puertoricans. To increase the knowledge of this plant, an ecological study was carried out emphasizing the correlations that exist between the abundance and dominance among these and the physical aspects of the cortex of the hosts they attack. There seems to be no host preference among these plants.

The existing correlation between the amount of mistletoe and the ecological parameters of the different stations was determined for the western and southern regions of Puerto Rico. Distributional maps of the species found in this study were made.

Since this plant attacks quite a number of important trees an attempt was mades to find a form of biological control that will eliminate the parasite without injuring the host. It was found that 25% of the pulp of "algarrobo", Hymenaea courbaril L., is very effective against this pest.

Biochemical tests of the fruit, stem and leaf of the species Phoradendron randiae, Phthirusa purpurea and Dendrophtora dominguensis were carried out. The transpiration rate of the mistletoes and their hosts were carried out where they were most abundant.

Mistletoes are generally distributed by some birds. A study of how the seed affects the digestive tract of doves was carried out. Results showed damage to the liver and the erythrocytes.

The possible allelopathetic effects of mistletoes on the germination and development of Phaseolus vulgaria were also determined. Extensive damage is found in the primary root and other parts of the plant.

#Third Award - American Phytopathological Society
Fourth Award - General Motors ISEF

#EMERGENCE FORCE OF SELECTED COTTON CULTIVARS

Barrentine, Kimberly A., Washington, Greenville, MS 38701; 124 Plantation Dr., Leland, MS 38756

Cotton seedlings must exert a force to push through the soil surface as they emerge. There are several cotton cultivars on the market which were developed under different edaphic conditions. These cultivars may differ in the force (grams per plant) exerted while emerging, and this force may be directly related to seed index (weight in grams per 100 seed). Five cotton cultivars were selected which had indicies ranging from 8.5 to 11.2 grams per 100 seed. A positive linear correlation of r = 0.7929 was found between seed index (grams per 100 seed) and emergence force (grams per plant). As the seed index increased from a low of 8.5 grams per 100 seed for Deltapine 41 to a high of 11.2 grams per 100 seed for Coker 3131, emergence force increased from 52.5 grams per plant to 90 grams per plant. Cotton cultivars do differ in their emergence force, and this force is directly related to seed index.

#Alternate to Scholarship - Ohio State University

A BIOMASS COMPARISON OF WET AND DRY SITES

Rogers, Paul H., Central H. S., Tuscaloosa, AL 35401; 2708 43rd Avenue E., Tuscaloosa, AL 35404

The weight of standing crop of plant biomass was greater ($p = .001$) in samples taken from poorly drained versus well drained areas in an old field. Ten biomass samples of one square meter each were taken from each of the two sites, and the hypothesis of equality of weight was tested using the Mann-Whitney test.

AN INTRIGUING LITTLE PLANT

Durbin, Paul A., Devils Lake Central High School, Devils Lake, ND 58301
Route # 5 Box 356, Devils Lake, ND 58301

PURPOSE: I want to explain moss's economic and evolutionary importances. I also want to show its antibiotic properties for its possible use in medicine.
PROCEDURE: A) I grew moss protonema from spores in liquid moss media so I would be able to see how moss starts its life cycle. B) In order to show moss's antibiotic properties, I ran tests involving the making of sterile agar plates and the culturing of different types of pure bacteria on them. In the first group of tests, I added raw moss. To the second group of tests, I used extracts of moss. C) I collected several different types of moss from around the Devils Lake area. I used these in my experiments. D) I made several slides of moss with a microtome and then mounted the specimens in balsam to make them permanent and photographable. E) I developed my own slides.
CONCLUSION: Moss has an evolutionary importance because it is a link between Thallophytes and Tracheophytes. It is a pioneer plant. Moss's economic importance is shown in the fact that it could be used as a medicine because of its antibiotic properties.

THE EFFECTS OF 400 AND 4K HERTZ SOUND ON GERMINATING SEEDS

Collier, G. A. III, Friona H.S., Friona, Texas 79035;
Rt. 3, Box 123, Friona, Texas 79035.

The purpose of this project is to determine if 400 or 4K Hertz sound waves will effect the germination rate of six agricultural crops.

Electrical equipment was calibrated with an oscilloscope.

Six seed varieties out of nine were chosen for their rapid germination rate.

Eighty-one seeds from each group were placed in nine cups per seed group, and then hydrated with 10 ml. of water. This initial watering began the sound interval which lasted for the duration of 12, 24, 48, 72, or 96 hours.

Raw data, taken from germination counts, were used in the "t" tests and converted to percentages for the graphs.

Analysis of the data yielded the following results:

Sunflower germination rate is increased by 12 hrs. of 4K Hz., but 96 hours decreases this rate. 12, 24, 72, and 96 hours of 400 Hz. increases germination rate.

Wheat and tricale are not effected by 400 or 4K Hertz.

Cotton germination rate is increased by 12 hours of 400 Hz. but after this it decreases. Cotton germination rate is increased by 12 and 48 hours of 4K Hertz.

Corn germination rate is increased by 12 hours of 4K Hertz, but after this it decreases. Forty-eight and 72 hours of 400 Hertz decreases germination rate.

Oat germination rate is increased by 12 hrs. of 4K Hz., but beyond this point it decreases. 96 hours of 400 Hertz increases germination rate but 12, 48, and 72 hours of 400 Hz. decreases the germination rate.

#Fourth Award - General Motors ISEF

THE ROLE OF CARBON AND POLY-PHOSPHATE IN INCREASING PLANT GROWTH TO FEED A HUNGRY WORLD

Ashmead, Stephen D., Davis H.S., Kaysville, Utah 84037
304 So., Mountain Road, Fruit Heights, UT 84037

Two greenhouse experiments were undertaken to study (1) the effects of carbon and poly-phosphate on the growth, and mineral content of the plant, (2) if there is any synergistic effect between carbon and poly-phosphate, and (3) the effects of the penetrants azone and dimethyl sulfoxide on carbon and poly-phosphate uptake in plants. Various combinations of carbon as activated charcoal, poly-phosphate, azone and dimethyl sulfoxide were used in the treatments. One experiment involved the application of the treatments to the leaves and the other involved soaking the seeds prior to planting.

The results indicated that carbon in the form of activated charcoal favorably affected mineral uptake and carbon usage. Increased carbon in plants did favorably effect plant growth, as shown by tissue dry weight through aiding mineral content, carbohydrate and/or amino acid synthesis. Poly-phosphate applied to the foliage affected plant growth. Penetrants dimethyl sulfoxide and azone helped activated charcoal and poly-phosphate on their effect on plants when applied to the foliage of the plants. There was no synergistic effect between poly-phosphate and charcoal. Poly-phosphate with the addition of dimethyl sulfoxide affected the growth, mineral uptake and carbon usage of plants when applied to the foliage of plants.

These favorable effects on plants may increase crop yields hence contributing to the available supply of food.

#GERMINATION ECOLOGY OF MOUNTAIN MAHOGANY, CERCOCARPUS MONTANUS

Lindauer, Kevin L., John F. Kennedy H.S., Denver, CO 80227
3039 South Depew Street, Denver, CO 80227

Cercocarpus montanus Raf. seed were collected along the front range near Morrison, Colorado during September, 1983. Germination and self-planting tests were conducted in the laboratory. Factors considered for germination were temperature, light, prechilling, and after-ripening. Alternating relative humidities were considered in tests on the self-planting mechanism. Freshly harvested seed exhibited innate dormancy the intensity of which was removed by prechilling treatments of 30 days. Seed given alternating night-day temperatures of 10-25, 15-20, and 15-25° C showed significantly higher germination values than seed given warmer night-day temperatures. Significantly greater number of twists occurred in the plumose styles of seed given low relative humidity treatments. Higher relative humidities resulted in straightening of plumose styles. Alternating relative humidities caused a "drilling" action that resulted in the seed being forced into the soil. The greater the number of alternating treatments, the greater the depth of self-planting. The adaptation to and survival of Cercocarpus montanus Raf. in its particular habitat is directly related to the time of seed dispersal, self-planting process, and the factors involved in breaking seed dormancy. All of these responses and mechanisms reflect a physiological adaptation of this species to its habitat.

#London International Youth Science Fortnight - United States Navy/Office of Naval Research
Third Award - General Motors ISEF

A STUDY OF THE EFFECTS VARIOUS SOUND FREQUENCIES HAVE ON THE GROWTH AND GERMINATION OF MONOCOTYLEDONS AND DICOTYLEDONS. PHASE III.

Johnson, Cynthia Ruth, Briarwood School, Palatka, Florida 32077
Post Office Box 455, Palatka, Florida 32078

The purpose of these experiments is to prove that the use of sound frequencies helps to stimulate the germination and growth of Monocotyledons and Dicotyledons.

In the first six experiments, corn seeds, bean seeds, marigold plants, and liriope plants were exposed to various sound frequencies produced by an audiometer. Comparisons were made between these plants and two controls. In experiments seven and eight, petunia and onion plants were exposed to the sound frequency which caused the best plant growth in experiments one through six. Experiment nine involved the construction of a potometer which indicated that sound affects water transpiration rate, and experiment ten which proved that sound affects the rate of photosynthesis.

Through all of these experiments a conclusion can be drawn; Sound has a very positive affect on plant growth. The sound frequency which had the greatest positive effect on plant growth was one thousand hertz. Plants exposed to the sound frequencies within the average person's speaking range were recorded as having the fastest growth. In conclusion: The growth, germination, transpiration rate, and photosynthetic rate were all enhanced by exposure to sound.

The conclusions drawn from these experiments may be applicable to help scientists, gardeners or farmers to obtain a much better understanding of sound's effects on their plants. With further research in this area a very promising growth stimulant may be recognized.

THE EFFECT OF KINETIN ON GROWTH OF SOYBEAN CALLUS TISSUE IN VITRO

Dennis A. Buesching, E. Nelson Snider High School, Fort Wayne IN 46815, 8318 Park State Drive, Fort Wayne, IN 46815

The main objective of this study was to find the best Kinetin concentration of the soybean callus. By doing this an optimum formula could be ascertained.

Experiments were set up using 5 different concentrations of Kinetin 0, .5, 5, 50 and 100. After this was added to the media, a sterile callus growth was then placed on the media. This growth was left to grow for four weeks. At this point, the data was formulated.

Upon visual examination and qualitative measurements of the data, it was determined that the mean of the results could be utilized in order to develop a formula.

Through experimentation and identification, it was determined that the optimum Kinetin level for the soybean callus was 5 or .5 milligrams per liter.

IMMUNIZATION OF CUCUMBER AGAINST COLLETOTRICHUM LAGENARIUM

Johnson, Polly, Paducah Tilghman H. S., Paducah, KY 42001; 635 Woodland Drive, Paducah, KY 42001.

The purpose of this research was to determine if Cucumis sativus (cucumber) plants could be immunized against Colletotrichum lagenarium. Plants were divided into Experimental and Control Groups. Experimental Groups were initially innoculated with twenty drops of a spore suspension of Colletotrichum lagenarium per first leaf when the first leaf was almost fully expanded. Control Groups were initially innoculated with twenty drops of water per first leaf. One week later the Experimental and the Control Groups were both challenge innoculated with twenty drops of a spore suspension of Colletotrichum lagenarium per second leaf. Symptoms were compared and the immune capacity was displayed by the Experimental Groups as they exhibited a significantly ($0.01>p>0.001$ and $0.05>p>0.01$) smaller area of lesions than did the Control Groups (area of 14.35 $cm.^2$ to 6.44 $cm.^2$). It was also found that immunization had no effect on the plant's height during the observation period of this research ($0.5<p<0.7$ and $0.10<p<0.30$). From this research it also appears that plants can be immunized through the soil.

*Alternate to Scholarship - Ohio State University

BUILD YOUR OWN PLANT

Walker, Robert W., Jefferson H.S., Shenandoah Junction, WV 25442 Rt. 1, Box 7 282, Charles Town, WV 25414

No abstract received.

THE EFFECTS OF FORMALDEHYDE ON DOMESTIC PLANTS

Johnson, Juliet E., Cortez H.S., Phoenix, AZ 85021;
8058 North 31st Lane, Phoenix, AZ 85021

The purpose of my project was to find out what genetic changes occur in Phaseolus vulgaris, Zea mays, and Pisum sativum after the addition of formaldehyde, and to see if formaldehyde had any visible effects. Formaldehyde has been proven to cause protein cross-links and single-strand DNA breaks in human bronchial cells, which mars their reproductive ability. Because plants are often exposed to formaldehyde in commercial products such as fumigants, seed protectants, and plant disinfectants, it is very important to find out if these products harm them.

To conduct my testing, I grew seventy-five plants divived into five groups of fifteen. Each group received a different amount of formaldehyde over a period of thirty days, with group one being a control. At the end of this time I totaled the physical results and extracted the DNA from the plants. I found that formaldehyde probably causes protein cross-links that harm the DNA, and causes the plant to acquire a reddish tinge.

There are many implications to these findings, but the most important is that protein cross-links in our domestic plants may cause a reduction or mutation of our crops, cutting down the food supply to a hungry world. This area needs to be researched much further -- my project just opens the door for further study. This problem is so important to agriculture, industry, and medicine that it cannot continue to be ignored.

CHEMISTRY

COMPUTERS IN CHEMISTRY

Rhees, Jon L., Bonanza H.S., Las Vegas, NV 89102;
1660 S. Duneville, Las Vegas, Nevada 89102

Computers are currently playing a tremendous part in our lives, especially science. Computers can be programmed to solve any type of equation. They can also be programmed to keep track of various chemical data, such as formulas, elements, masses of elements, etc. . .

This project is designed to investigate how a computer can play such a role in chemistry. It is acieved by programming a computer to solve various chemical formulas, to handle data for each element in chemistry, and to be able to recall certain data for quizzing purposes.

The program represented in this lab is written in Basic; a programming language commonly found in home computers. The program has been d.signed to incorporate computer graphics and sound to make it more interesting for the operator, and easier to understand. The program also contains a quiz option for the use of learning elements and their formulas, if desired.

Computers can be found to be quite useful in chemical, physical, and mathematical problem solving. Because of the high speed in which computers operate, extra tedious tasks are an excellent application of the computer. In our daily lives, computers are playing a larger and larger part in our work in society. As a result of this, we take advantage of computers through science.

THERMODYNAMICS AND KINETICS OF AN OSCILLATING CHEMICAL REACTION

Vu, Lan N., Newman Smith H.S., Carrollton, Tx 75006
1844 Post Oak Ln., Carrollton, Tx 75007

A solution consists of H_2O_2, Mn^{+2}, IO_3^-, $CH_2(COOH)_2$, H^+, and starch at certain proportion will oscillate in colors continuously from clear to yellow to blue. At the same time, $[I_2]$, $[I^-]$, and gas production are also oscillating. In this project, elementary reactions in this oscillating reaction are identified and thoroughly studied. Two elementary reactions important in iodine production are:

1. $2H^+ + 5H_2O_2 + 2IO_3^- \xrightarrow{Mn^{+2}} 5O_2 + I_2 + 6H_2O$
2. $IO_3^- + 5I^- + 6H^+ \longrightarrow 3I_2 + 3H_2O$

They are coupled with iodine consuming reaction 3.

3. $CH_2(COOH)_2 + I_2 \longrightarrow CHI(COOH)_2 + I^- + H^+$

Rxn 1 is faster than rxn 3 when the $[I^-]$ is low. As a result, the $[I_2]$ rapidly increases; the $[I^-]$ increases shortly afterward. When the $[I^-]$ reaches a certain level, a slower I_2 producing rxn 2 replaces rxn 1. Combined with rxn 3, the result is a consumption of I_2; the $[I^-]$ decreases sharply after all of the I_2 has been used up. When the $[I^-]$ has decreased enough, rxn 1 can start over again. This same process will repeat continuously during the oscillatory period until one of the reactants (H_2O_2, $CH_2(COOH)_2$, or IO_3^-) is used up. Others minor reactions that are not involved in causing oscillations but are taking place in the oscillating system have also been included in the mechanism to explain the appearance of the blue color and the CO_2 evolution.

#First Award - Chemical Abstracts Service
First Award - General Motors ISEF
Second Award - American Chemical Society

#THE DEVELOPMENT AND APPLICATION OF AN AUTOMATED FLAME PHOTOMETER

Wood, Mark C., Walkersville H.S., Walkersville, MD 21793
8382 Discovery Blvd,. Walkersville, MD 21793.

The purpose of this project is to develop, construct, and apply both software and hardware componets necessary for an automated homemade flame photometer. The flame photometer was constructed from the following items: Meeker burner, photographic filter, photo circuit, optical train, air supply, and medical atomizer. The TRS-80 Model I computer interface was built and tested using modified peripheal interface circuitry. Associated software programs were also developed to operate the analog to digital conversion circuitry, collect data, and plot data. The flame photometer was then used to determine flame emission for various cancentrations of solutions. Major conclusions are: (1) intensity v.s. concentration yields a linear realationship, (2) automation of the flame photometer allows data to be collected faster and more conveniently, (3) analysis of data can be accomplished with greater efficiency using the software graphing program, (4) computer automation provides more objective data collection.

#Fourth Award - General Motors ISEF

#DETERMINING A MECHANISM FOR TRIBOLUMINUSCENCE

Tennison, John T., Texarkana Arkansas H.S., Texarkana, AR 75502;
2003 County Avenue, Texarkana, AR 75502

The purpose of this project was to determine a mechanism, or cause, for triboluminescence. Triboluminescence is the light emitted when mechanical stress is applied to a solid. Results were obtained by observing characteristics of triboluminescent substances in various environments.

Various substances were crushed or ground to see if they possessed triboluminescence. A test chamber was built so that substances could be crushed and photographed in air, in a vacuum, and in low pressure neon. The substances that were found to be triboluminescent were also crushed under water. Photographs were made of the glows from several substances that were crushed in the test chamber.

In every case for a substance to glow, it must be fractured. Results indicate that triboluminescence is caused either directly or indirectly by ambient gases. Other conclusions that were made are as follows: Triboluminescence is caused only in hard solids; soft substances will not glow when they are crushed; and the glow from sugarless substances was always dimmer than the glow from substances that did have sugar.

Future studies will include testing a larger variety of substances, spectroscopic analyses of triboluminescent glows, and photographing substances that were crushed in various gases.

#Fourth Award - General Motors ISEF

#ELECTROCHEMICAL REDUCTION OF ALLENIC KETONES IN DIMETHYLFORMAMIDE

Wolfe, Steven F., Cardozo H.S., Bayside, NY 11364
67-33 214st. Bayside, NY 11364

During the past two decades the reductive cyclization of various compounds has been studied. Although several non-conjugated ketones have been studied, conjugated ketones have not. The purpose of this research was to determine the mechanisms of electrochemical reduction of allenic ketones. It has been shown that certain compounds give intramolecular cycloaddition products when reduced (Shono, et al., 1978). It is believed that allenic ketones give a five-membered carbocycle which may be used to synthesize (biologically) important compounds that may not be synthesized using other chemical means.

The compound of interest, which is not commercially available, had to be synthesized. Although the reaction was not completed, the intermediates of the synthesis were obtained and identified by NMR spectroscopy and IR spectrophotometry.

These compounds were investigated electrochemically to provide information essential to understanding the electrochemical reduction of allenic ketones. Polarograms of these compounds show several reduction waves, indicating that these compounds are electroactive.

Further studies are required to determine the mechanisms of these reactions. Likewise, the process requires examination from an organic chemical point-of-view. Many important compounds have similar structures to the proposed product of these studies such as steroids and other drugs.

#Second Award - United States Air Force
Honorable Mention - American Chemical Society

USING CHEMICALS TO ETCH COPPER FOR PRINTMAKING

Craft, Lydia G., N. Fl. Christian School Tallahassee, Fl. 32312
Rt. 5 Box 612 Tallahassee Fl. 32301

Purpose: To determine which chemicals etch copper and of these chemicals, which etch copper the best for printmaking.

Hypothesis: $FeCl_3$ is used commercially to etch copper with the reaction being $4FeCl_3 + 2Cu\ H2O\ 4FeCl_2 + (Cu(H_2O)_4)^{+2}\ (CuCl_4)^{-2}$. The voltage of a complete reaction can be determined by combining it's half reactions. For instance: $Fe^{+3} + e^-$ Fe^{+2} $E^0 = +.771$, Cu^0 $Cu^{+2} + 2e^-$ $E^0 = -.337$. $+.771 + -.337 = +.434$. The energy potential for a reaction between Fe^{+3} and Cu is greater than the highly negative energy potential for a reaction between Cl and Cu. I concluded that Fe^{+3} does the work in the $FeCl_3$ solution. My experiments were done using ferric compounds.

Procedure: Covered 1" copper plates with acid resist. Removed the same amount of acid resist from each plate by tracing a stencil. Prepared 1M and 3M solutions of ferric compounds. Submerged plates in each solution for 30 and 50 minutes,printed those plates that etched, and weighed them with an analytical balance to determine weight loss after each period of time. Prepared saturated solutions of $FeNO_3$ and $FeCl_3$, as well as these solutions with a ½ ml of HCl per 20 ml to aid in solubility. Prepared 4M and 7M solutions of HNO_3, submerged a plate in each solution, removing and weighing five times each at 30 min. intervals.Repeated and graphed the speeds of the etches. Conclusion: I compared print results, the solubility,safety, and cost of solutions, and the speed of etching. The chemchemicals that may be used to etch copper for printmaking are listed in decreasing order of their practicality: $FeNO_3$, $FeCl_3$, HNO_3, and $FeNH_4SO_4$.

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NITRITE IN HOT DOGS: ONLY YOUR CHEMIST KNOWS

Martin, Deborah M., Ephrata H.S., Ephrata, PA 17522
1349 Main St., Akron, PA 17501

The purpose of this project was to use a colorimetric method to compare the nitrite content in various brands of hot dogs and to determine if the method of preparing the hot dog for eating affects the nitrite. Five different brands of hot dogs were tested using samples that were left uncooked, heated in the microwave oven and heated in boiling water.

Samples of hot dogs were macerated in a blender and the resulting solutions were put through a series of vacuum filtrations to produce a clear nitrite-containing extract. Samples of the nitrite extract were added to a colorimetric indicator solution and the percent transmittance was measured using a spectrophotometer. The nitrite content in parts per million (ppm) was determined through the use of a Beer's Law curve that had been prepared from a set of standard nitrite solutions.

Samples of nitrite-free sausage were spiked with known quantities of nitrite and analyzed using the same procedure to determine the percent recovery of the process. The nitrite levels found in the hot dogs were then corrected using this value.

The nitrite content of the brands of hot dogs tested was found to be significantly lower than the maximum level allowed by federal regulations. The method of preparation of the hot dogs had a definite effect on the nitrite content. In four of the five brands tested, cooking in a microwave oven caused a slight decrease in the nitrite content of the hot dogs. In all five brands tested, the nitrite content was significantly reduced when the hot dog was heated in boiling water.

#EUPHORBIA LACTEA AS A FUTURE FUEL ALTERNATIVE

Muñoz Camps, Johnny, Eloísa Pascual High School
Caguas Norte, Caguas, Puerto Rico 00625

One of the mayor problems the whole world is facing today is the lack of fuels. Different alternatives are considered to solve this problem.

In phase one of my research work 50 grams of the upper part of the stem of Euphorbia Lactea was macerated with 100mls of acetone. The same was done separately with 50 grams of the petioles (thorns).

In phase two the process was repeated with 334 grams of the upper part of the stems. The same was done separately with 268 grams of petioles.

In both cases various extractions and filtrations were made. Acetone residue was eliminate by using a soxhlet apparatus placed in a doble boiler. In each case a very dense oil was separated with similar features of a fuel. One drop of the oil obtained from the petiole was placed in a metal spatula to which a flame was applied. It burned for about one second. A drop of oil obtained from the stem was treated the same way and it burned for about three minutes.

Séctrophotometry, gas chromatography and Nuclear Magnetic Resonance Spectra were done.

The result obtained was a hydrocarbon with a high molecular weight. I conclude that the Euphorbia Lactea stem and its petioles could be used as a fuel in the near future.

My goal for the future is to continue my research with the Euphorbia Lactea to verify its use.

#Fourth Award - General Motors ISEF
Honorable Mention - Gulf Oil Corporation
Honorable Mention - United States Air Force

SPECTROPHOTOMETRIC ANALYZATION - DISCOVERY, DEVELOPMENT, AND SUBSTANTIATION FOR DETERMINATION OF VITAMIN C

Woodward, Lisa, Brush High School, Brush, CO 80723
27444 Rd. Y. Snyder, CO 80750

In the past, the procedure for testing vitamin C has been complicated and time consuming, using titrational apparatus and technique. After completing two years of investigating vitamin C decomposition using titrational analysis, a faster and more accurate method was perceived. Spectrophotometric analysis, as an innovative procedure, was discovered, developed, and substantiated. This was achieved using a Hach colorimeter and methylene blue as an indicator. Five solutions were made, a 1%, .75%, .5%, .25%, and .1%. A known quantity of methylene blue was added as an indicator. Using a 500 nm light filter, absorption values for each solution were marked on a blank scale. This scale was then used to calculate unknown values of ascorbic acid. (vitamin C) All the values found using spectrophotometric analysis were compared to values found using titrational analysis to substantiate the validity. This new method is easier to use, faster, and more accurate as a method of determining vitamin C concentration in a solution.

THE OPTICS OF SOAP FILM, Bobby D. Butler
CARVER AREA HIGH SCHOOL, CHICAGO, IL 60627
13256 South Greenwood, Chicago., Il 60627

The research was performed to observe and to study some physical properties of soap film, including the optical and draining properties, and to relate these to the chemical composition of the films. A variety of soap solutions of varying chemical compositions were tested at different concentrations to observe the optical and surface properties of the films. The films were formed on rectangular wire rings and carefully placed in a black box which was enclosed to prevent air current interference, while providing a clear view for observations. The spacing of color bands, appearance of the black film, measure of marginal regeneration and the "life-span" (duration) of films were selected as experimental variables. Supplemental experiments were completed to illustrate light diffraction of the monomolecular surface layer observed with amphipathic molecules. The experiments revealed that the chemical make-up of soap film affect reflection and refraction of light by changing the thickness of the film. There may exist a relationship between the chemical composition and the reflection and refraction of light in a soap film because with chemically different soap films, various patterns, frequencies and brightnesses of color were observed.

FREEZE-THAW FLOTATION OF ALUMINA AS A BASIS FOR MINERAL PROCESSING
Kubes, Joseph Scott, F.W. Springstead High School, Spring Hill, Florida 33526; 2288 Evenglow Avenue, Spring Hill, Florida 33526.

The purpose of this project is to discover the effect freeze-thaw pretreatment has on mineral processing. It is hoped that these results can provide a way to recover more mineral at a lower cost. These results, in fact, did indicate a positive note; the flotation of alumina (Al_2O_3) was increased from 60% to about 95%, an increase of 35%.

These results are a basis only; research into specific minerals must be carried out separately.

#ELECTROPLATING
Nevulis, Leonard, Lake Catholic H.S., Mentor, OH 44060
2399 Stanford Dr., Wickliffe, Ohio 44092

The purpose of this project was to develop a better electroplated coating.

Different wave forms were first used to plate low carbon steel substrates. After a wave form is found that produces different properties it is used under different conditions of temperature and current density. The plating done on the test level is done in a Hull Cell. The range of the properties under different current densities is determined by measuring the distance of its limits along the Cathode. Thickness is measured at centimeter intervals along the cathode. Finally the quality of the brightness of the deposit is tested.

Periodic Reverse current of the order of 1.75s forward .75 seconds reverse yields the most optimum coating;increasing the throwing power of an Acid Copper Bath from -84.6% to -81.6%, and an Acid Zinc Bath from -84% to -82%.

Periodic Reverse current increases the brightness of both a copper and a nickel deposit. It increases the throwing power of Acid Copper and Zinc Baths, and does not work with a Chromic Acid Bath. Periodic Reverse current increases the brightness of successive layers of different plated elements such as chromium over nickel over copper.

Periodic Reverse current can be used to increase the brightness of deposits without additional agents in the bath. This can reduce both the time and cost of normal plating operations.

#Third Award - General Motors ISEF

#BLEOMYCIN-INDUCED DEGRADATION OF DNA IN THE PRESENCE OF CHELATORS AND METAL IONS

Sharma, Prabodh, Cheltenham H.S., Wyncote, PA 19095;
7941 Heather Road, Elkins Park, PA 19117

Bleomycin, a recent anti-neoplast, is a glyco-peptide, highly efficient in degradaing DNA of cancerous cells at the G2 phase of cell-divisions. Its degradation of DNA was studied both in the absence as well as presence of chelators, reducing agents, metal ions, and a superoxide anion generating system provided by the combination of xanthine oxidase and hypoxanthine. Chelators used were EDTA, and deferoxamine, an Fe(III)-specific polyhydroxamic acid and chelator. Reducing agents used were 2-mercaptoethanol and ascorbate; and metal ions studied were Cu(II), Co(II), Zn(II) and Ni(II).

Combined with reducing agents, Bleomycin produced a much more efficient degradation of DNA than it did as a single agent. Chelators inhibited all Bleomycin-induced DNA cleavages and, upon further investigation, deferoxamine showed a much greater inhibitory effect than equimolar EDTA. The pattern of enhancement and inhibition by reducing agents and chelators, respectively, was found related to the involvement of iron as the most important co-factor in Bleomycin-induced DNA cleavage. Co(II), Cu(II), Zn(II), and Ni(II), unlike Fe(II), inhibited DNA cleavage by Bleomycin even in the absence as in the presence of reducing agents.

From the pattern of the interactions of Bleomycin with the chemical agents studied, a modified model for the action of Bleomycin was proposed, in which the degradation of DNA was found associated with the oxidation of DNA-Fe(II)-Bleomycin complex, involving iron as the ultimate co-factor in the process of degradation.

#Second Award - General Motors ISEF

Alternate to Scholarship - Ohio State University

Honorable Mention - American Chemical Society

Honorable Mention - United States Army

#COLOR MY PEAS PURPLE!

Pyott, Aimee S., Owyhee Combined School, Owyhee, NV 89832
P.O. Box 387, Owyhee, NV 89832.

Using a paper chromotography technique I found there is more to color than meets the eye. The colors of different water soluable marking pens diffused into their component dyes. The purple, black, blue, orange, brown and green appeared to be composits of two or three dyes. The yellow and red appeared more homogenious. A consistant pattern of diffusion resulted with blue being the most soluable followed by yellow and then red.

Some commercial food color additives were then tested to see if the dyes could be separated and a consistent pattern of diffusion would result similar to the first observations. The paste food colors and the extracted colors from M&M candies diffused into similar patterns. The greens, browns, and black separated into at least two dyes. It is apparent that in both pattern of diffusion and presence of dye combination the food color additives tested were very similar to the original observations using water color marking pens.

It is common practice for food manufacturers to add color dyes to their products to make them more appealing. However, some of the color components used may be harmful to human health. Let us be content with green peas!

#First Award - American Medical Association

#TOXICITY OF PIPERINE SOLUTIONS TO HOUSEFLIES

Tanner, Martha, Haworth H.S., Kokomo, IN 46902
628 S. Malfalfa Rd., Kokomo, IN 46902

The need for non-toxic insecticides is great both inside and outside the house. In an effort to develop such an insecticide, piperine, an organic substance with a potential of being toxic to houseflies, was used. This compound occurs naturally in small concentrations in black pepper. An attempt was made to extract this substance from black pepper and test its toxicity to houseflies.

Piperine was extracted from black pepper using a distillation with ethanol and an extraction with ether, followed by thin layer chromatographic separation. It proved difficult to obtain large enough quantities of piperine from the plates, so piperine was purchased instead. An infrared spectrum was run on a sample of this piperine for future comparison.

Two substances, piperine and Raid Natural, a commercial, household insecticide, were tested. Each of these was dissolved in acetone, then spread on a glass plate. The acetone was allowed to evaporate, leaving a residue of the Raid or piperine. Flies, which had been hatched from pupae, were exposed to these plates and mortality rates recorded. In addition, a test was done in which piperine was added to the flies' food.

While Raid was more effective over a short period of time, its toxicity soon vanished. Though piperine lacked this rapid paralysing effect, it was effective over a longer period of time and failed to lose its toxicity throughout the testing period. With this long-lasting toxicity, piperine could, in conjunction with other toxic ingredients, be used as an effective, natural insecticide.

#Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent Office Society

A BURNING ISSUE - FLAME RETARDATION

Charrier, Janna R., Bottineau H.S., Bottineau, ND 58318
611 West Pine Circle, Bottineau, ND 58318

The purpose of this project was to determine if flame retardation is worth the time, effort and money involved. The different types of categories used in this experiment were: clothing, sleepwear, mattresses, draperies, insulation and carpeting.

I treated samples of commercially untreated fabric and burned them. I also burned samples of commercially treated fabric. I then burned samples that were not treated to compare them with the commercially treated and laboratory treated samples.

I used three different formulas for the laboratory treated samples to determine which would be the best.

Because no single formula proved the most effective in all of the samples, I have come to the conclusion that the effectiveness of a particular formula depends on the contents of the fabric being treated.

As a result of my testing and research, I have come to the conclusion that flame retardation is indeed worth all of the time, money and effort spent.

THE ROLE OF METASTABLE PHASES IN THE SYNTHESIS OF MAGNETIC OXIDES FROM ORGANOMETALLIC PRECURSORS

Quan, Roger W., Cass Technical H.S., Detroit, MI 48201
7661 Fielding St., Detroit, MI 48228

Organometallics and magnetics oxides are important high technology materials. Applications of organometallic precursors in the production of magnetic oxides have been based mainly on achieving lower reaction temperatures and controlled morphologies of the particles in the powders and ceramic bodies.

In this investigation, mixed organometallic/inorganic coprecipitates have been prepared and employed as precursors for the synthesis of complex magnetic oxides with the general formula, $MFe_{12}O_{19}$, where M= alkaline earth ion. These magnetic oxides are known as magnetoplumbite type hexagonal ferrite and find important applications in permanent magnets and microwave communication devices.

The detailed reaction mechanism for the synthesis of these magnetic oxides have been determined by means of differential thermal analysis, thermogravimetric analysis, x-ray powder diffraction, and other standard techniques of solid state chemistry.

Using a variety of preparative methodologies, it has been determined that a novel intermediate is, indeed, formed during the synthesis of $SrFe_{12}O_{19}$ from the mixed, organometallic/inorganic coprecipitated precursors of strontium laurate and iron hydroxide. The formation of the intermediate and its subsequent reactions is primarily responsible for the development of the crystalline hexagonal ferrite at the low temperatures observed in this study. For the first time, the conditions leading to the formation of this intermediate have been determined.

RESIDUES OF CYPERUS ROTUNDUS AS AN ORGANIC FERTILIZERS AGENT IN SOILS, AND ITS ACTION FOR PLANTS GROWING

García, Hylsa E., Ponce High School
Ponce, P.R. 00731
6 Q-20 Ext. San Antonio, Ponce, P.R. 00731

My investigation compreses the study of different types of soils in P.R., their yield in terms of crops and the increase in yield using Cyperus as a fertilizing agent. Chemical analysis of extracts obtained from Cyperus residues showed high levels of nitrogen, potassium, phosphorus, proteins and two enzymatic substances: Alkaline phosphatase and oxalacetic glutamic transaminase. Field experimentation demonstrated that Cyperus residues improves soil texture, oxygen absortion by soil, drainage, organic matter absortion and water intake. Cyperus extracts improves ph of soils and gives to it a richer, darker color which is an indicator of fertility. Seed germination of plants such as white beans (phaseoulus vulgaris) and native large pepper (capsicum annum) demonstrated that in soils treated with Cyperus residues, germination and growth were very much improved. Based on data obtained from my investigation, and having done a comparative analysis of Cyperus with other organic fertilizers as: cow, horse, chicken and goat excrement and a comparative analysis of Cyperus with inorganic fertilizers, I can reach to conclusions demonstrating that Cyperus residues are an excellent organic fertilizer for man-made and other type of soils in P.R. Cyperus action with soils demonstrate biochemical activities such as: (1) Amino acid breakdown- ammonification: $CH_3\ CHNH_2\ COOH + 1/2\ O_2 \xrightarrow{\text{alanine deaminase}} CH_3\ COCOOH + NH_3$. (2) Oxidation of ammonia to nitrite by nitrosomonas: $2NH_3 + 3O_2 \longrightarrow 2HNO_2 + 2H_2O$. (3) Oxidation of nitrite to nitrate by nitrobacter: $HNO_2 + 1/2\ O_2 \longrightarrow HNO_3$. (4) Reduction of nitrate to ammonia: $HNO_3 + 4H_2 \longrightarrow NH_3 + 3H_2O$.

EXTRACTION, SEPARATION, AND PURIFICATION OF ANTHOCYANINS FOR USE AS A NATURAL FOOD COLORANT

Carson, Anne M., Bishop Chatard High School, Indianapolis, In 46220
4054 N. Pennsylvania St., Indianapolis, In 46205

In recent years the F.D.A. has been banning the use of various coal-tar dyes in coloring foods. In an effort to provide the public with palatable food, other kinds of food dyes are being researched. Anthocyanin pigments are one of the alternatives. Anthocyanins are the red and blue pigments present in some plants, fruits, and flowers.

Anthocyanins were obtained through extraction from grape pomace that was obtained from Easley's Winery of Indianapolis. In the first extraction, four different solvent systems were run through percolators packed with grape pomace. The solvent to pomace ratio was 500 ml.: 50 grams. In the second extraction, one solvent system was chosen from the solvent systems tested in the first extraction. The solvent to pomace ratio was scaled up to 6 l.: 1 kg. In order to observe the reactions of the extracts obtained in the first extraction under experimental conditions, TLC was performed on the extracts on 20 cm. by 20 cm. plates coated with three different adsorbants. In order to separate the components of the extract obtained in the second extraction, column chromatography was performed. The extract was first run through a small column, then through a larger column. In the larger column the color bands were fractioned from the column.

Conclusions to be made from the experimentation are that (1) out of the four solvent systems tried in the first extraction, MeOH with .03% HCl worked the best, (2) in the columns the solvent system containing 25:75 methylene chloride and methanoe respectively, had the best separation, and (3) there were three visible color bands present when the columns were developed.

#First Award - Ashland Chemical Company
Second Award - General Motors ISEF

MICELLE STABILIZATION OF A FLUORESCENT COMPOUND

Zoltewicz, Susie, Gainesville H.S., Gainesville, Fla. 32601;
2609 S.W. 9th Dr., Gainesville, Fla. 32601

A fluorescent, organic compound was synthesized by a literature procedure. The fluorophore then was subjected to hydrolysis in six alkaline buffer solutions. Added to five of these solutions were varying amounts of sodium dodecylsulfate, a surfactant which forms anionic micelles.

As the fluorescent compound underwent hydrolysis, the changes in its absorption spectrum were monitored in a spectrophotometer using ultra violet light. When these absorbance changes were plotted against time, the half-life of each reaction could be calculated. Half-lives were found to decrease with increasing pH at a constant concentration of micelle. Multiplying the half-life by the hydroxide ion concentration of each buffered reaction gave pH-independent values which were compared to give the relative rate of each reaction. Relative rates showed that the hydrolysis process was lengthened by a factor of 2.3, 9.8, 10.3, and 10.0 at progressively higher micelle concentrations. These results indicate (1) that the fluorescent compound is stabilized by the micelles, (2) that the maximum stabilization is a factor of approximately ten, and (3) that no additional protection can occur beyond the factor of ten because the micelles have become saturated with fluorophore.

#Honorable Mention - American Chemical Society

#THE SAFETY AND EFFICACY OF CCA TREATMENT OF LUMBER

Beaver, Roderick W., Loudoun Valley H.S., Purcellville, VA 22132; Route 1, Box 157A, Waterford, VA 22190.

Chromated copper arsenate (CCA) used to pressure treat lumber purportedly binds to the cellulose in wood and hence should not constitute an environmental hazard. However, under certain circumstances, arsenic might escape. The issue of the efficacy of CCA treatment in preventing wood decay is also relevant to its risk/benefit assessment.

To determine the effect of destroying the cellulose on CCA binding, CCA-treated lumber was burned; acidic leaching and extraction of the ashes yielded large amounts of arsenic (43-72 mg/gm ash). Atomic absorption spectroscopy gave the highest value, 112 mg arsenic/gm ash. This is 62% of the minimum theoretical yield (180 mg/gm ash). The rest of the arsenic probably sublimed, as did arsenic oxides heated with and without charcoal in test tubes. These results indicate that burning CCA-treated lumber does release the arsenic into the environment.

To measure the amount of arsenic that might leach from CCA-treated lumber, shavings were soaked in acid and alkaline solutions for several weeks. Little arsenic leached in plain water, but the amount increased dramatically at both ends of the pH scale, particularly in the acid range. CCA-treated slats buried for a year leached small amounts of arsenic into the surrounding soil. Sanding dust contained 7.1 times as much arsenic as the average minimum concentration in the lumber.

Slats cut from treated and untreated Southern pine were buried for 390 days under conditions designed to accelerate decay. Differences in their appearance and percent weight loss ($p < 0.001$) showed that the CCA treatment was effective in preventing decay.

CCA treatment is an effective method for preserving lumber, but appropriate safety precautions should be taken when using this product.

#Fourth Award - General Motors ISEF

EXPERIMENTING WITH THE RATE OF OSCILLATION IN A BELOUSOV SYSTEM

Sheets, Lorrie J., John Marshall High School, Rochester, MN 55901; 2515 13th Ave. NW, Rochester, MN 55901.

The purpose of my project is to explore how factors such as temperature, concentration of parent solution, and concentration of bromate in the Belousov reaction system affect the rate of oscillation.

In the Belousov system, ceric ions are reduced by malonic acid, and the resulting cerous ions are oxidized by bromate. Thus, the ceric/cerous ion concentrations oscillate as the system approaches equilibrium.

I used 1.5 M H_2SO_4 as a parent solution (solvent) for .002 M $Ce(NH_4)_2(NO_3)_6$ (ceric ammonium nitrate), .275 M $CH_2(COOH_2)$ (malonic acid), and .0625 M $KBrO_3$ (potassium bromate) solutions. I used 10 ml. of each of the three above solutions and 4 drops of ferroin, an oxidation-reduction indicator, for each test. As the ferroin indicator oscillated from sky blue to violet-red and back again, I noted the time it took for the oscillation to occur. The sky blue color appeared suddenly, so it made a good timing point.

In Part I of my study, I studied the effects of temperature on the rate of oscillation. In Part II, I studied the effects of different concentrations of the sulfuric acid parent solution on the rate of oscillation. In Part III, I studied the effects of different bromate concentrations on the rate of oscillation.

I found that the system oscillates at a faster rate at higher temperatures. Higher parent solution concentrations caused the oscillation rate to increase. Also, higher bromate concentrations caused the oscillation rate to increase.

#SYNTHESIS AND STUDY OF $Mo(CO)_4(PPh_2O)_2SiRR'$ COMPOUNDS

Redmill, Keith A., Resource Learning Center H.S., B'ham, Al. 35209
2268 Tyler Road, Birmingham, Al., 35226

Nuclear Magnetic Resonance (NMR) techniques can provide useful information about the structure and properties of a chemical compound. NMR techniques have also been used as a probe for electron density, but this has only been successful when the molecules are small and do not contain metals. When large compounds are to be analyzed using NMR techniques, many other parameters must be taken into account, including steric effects and sigma and pi bonding. If a reliable system can be found to determine the electron density at specific sites in large molecules, an entirely new range of possibilities would be opened. Since catalytic activity is determined by the electron density at key sights, catalysts could then be designed that would perform particular jobs in a predictable way.

I have synthesized a series of Molybdenum Carbonyl complexes, substituting different radical groups onto certain sites, and have studied them using NMR techniques. The changes within the different molecules were analyzed and they correlated well, indicating that the molecule is acting predictably as the radical groups are changed. The changes within the molecule also correlate well with the steric parameter (Es), which measures the changes within a compound caused by changing its size or geometry. This indicates that the molecule is being affected by the changing size of the radical. It should therefore be possible to substitute a radical on this compound and determine its steric parameter. The steric parameter of this radical, which is independent of its enviroment, can then be used along with other data to predict how new compounds will act.

#First Award - United States Army
Alternate to Scholarship - Ohio State University

THE INFLUENCE OF pH ON THE KINETIC ORDER AND RATE OF DEGRADATION OF VITAMIN C WHEN EXPOSED TO COPPER

Brady, Howard R., Ogden High School, Ogden, UT 84403
4160 Edgehill Drive, Ogden, UT 84403

From previous experiments, I have come to the following conclusions about the loss of vitamin C:

1. The loss of vitamin C can be accelerated quite substantially by adding copper powder to a vitamin C solution.
2. The loss (oxidation) of vitamin C is a second order reaction.
3. When oxalic acid is added to the vitamin C solution, the loss of vitamin C is drastically decreased.
4. Some irregularities in the kinetic order are experienced when copper is added to vitamin C.

The purpose of this project is to determine if pH is responsible for the irregularities experienced in relation to the kinetic order. This experiment yielded the following conclusions:

1. Because the kinetic order and rate constants cannot be computed, I am drawing the conclusion that the buffer system not only significantly controls the loss of vitamin C but also has some other effect on the results.
2. At pH 2.2, the loss of vitamin C increases at a moderate rate, then slopes downward to reach the highest rate of degradation at pH 3.6. After this point is reached, the general trend moves toward a lower rate of degradation, with the lowest rate appearing at pH 6.8. After this point is reached, the rate of degradation begins to increase again.
3. My hypothesis states that the lower the pH, the greater the vitamin C loss rate would be. I had not expected the vitamin C loss rate to decrease after it had reached its peak.

#THE INVESTIGATION OF RATE AND MECHANISM
OF AN OSCILLATING CHEMICAL REACTION

Martin Shipley, Los Alamos H.S., Los Alamos NM 87544
1646 Camino Uva, Los Alamos NM 87544

Oscillating chemical reactions have become very popular among scientists recently because more and more information is being discovered that can help scientists predict reactions that will oscillate. I have fabricated a computer-controlled spectrophotometer and a stopped/continuous flow reactor to study the reaction rate of the reaction and to monitor various components of the reaction. This data can be used to discover the complete reaction mechanism of the oscillator. That information can in turn be used to help in designing a systematic method of predicting oscillation in a chemical system.

The oscillator I have chosen is an Iodide-Iodate reaction in which the solution oscillates between a dark purple color and a yellow color with a period averaging fifteen seconds. The flow reactor consists of syringes which supply the reactants to a low volume cell mounted in my spectrophotometer where the reaction occurs. As the reaction progresses, the spectrophotometer combined with my computer measures the absorbance of the solution at a given wavelength. This data can help determine the rate of reaction and the rate equation of the system, and the data can be used to measure the absolute concentration of one of the intermediate products of the reaction.

#First Award - United States Air Force
Scholarship - United States Marine Corps
Second Award - Sigma Xi, the Scientific Research Society
Third Award - American Chemical Society
Third Award - General Motors ISEF
Alternate to Scholarship - Bowling Green State University

#Enthalpy-Volume Relaxations of Industrial Poly Vinyl Chloride (PVC) Films Annealed in the Glass Transition Region
(Nonequilibrium Structures in the Glassy State)

Ott, Derek A., Shawnee Mission East H. S., Shawnee Mission, KS 66208
7520 Aberdeen, Shawnee Mission, KS 66208

In an earlier study, the effects of annealing beneath the glass transition temperature on the properites of poly vinyl chloride was examined. The current research, which is based on the previous study, investigates the specific relationship between observed enthalpy-volume relaxations and annealing of slightly oriented, industrial poly vinyl chloride (PVC) films. The material was subjected to thermal treatment at 65, 70, 75, 80, and 85 ^{o}C for 1, 3.16, 10, 31.6, 100, 316, and 1000 hours. Differential scanning calorimetry (DSC) at 20 ^{o}C/minute and specific volume analysis (density gradient column) were used to examine the effects of this annealing near and below the glass transition temperature (Tg). Nonlinear effects in the volume-enthalpy relaxation at relatively long annealing times and at temperatures near the glass transiton region produced deviations in the specific heat curves at temperatures (120 ^{o}C) far above Tg (85-95 ^{o}C). This phenomenon, which seemed to be realted to observed volume effects, occurred in addition to normal overshoot effects in the DSC curves. A possible explanation of the data could involve the production of clusters, which were formed during the nonequilibrium vitrification process and altered by the following thermal treatment.

#Fourth Award - General Motors ISEF

*ELECTROCHEMICAL UTILIZATION OF OILFIELD WASTE WATER

Ashton, Lowe B., Williston H.S., Williston, ND 58801;
305 3rd Ave. East., Williston, ND 58801

This project was engineered to develop a practical chemical process which converts waste saltwater produced by oil and gas wells into usable compounds. Scrap iron used as the positive electrode is converted to Iron Oxide, also a valuable raw material in the oil industry used to absorb toxic H_2S Gas. The entire process is accomplished according to the principles of electrochemistry. The skeleton design consists of waste brine as the reactant with Sodium Hydroxide, Hydrochloric Acid, Calcium Carbonate, Iron Oxide, and Magnesium Carbonate as the products, all of which are useful and economically important in the same general vicinity where the oilfield waste water is produced.

The procedure involves passing a controlled electric current through the brine of a measured resistance for a specific time interval. Variables continuing through the process include changing surface areas of electrodes, changing current density, changing resistance of electrolyte, and changing proportions of materials produced. Allowances for these variables have been made in the project outline and in the conclusions and economic projections. Economic projections are presented based on raw material costs, energy consumed, and the value of the produced chemicals.

@First Award - American Intellectual Property Law Association
Fifth Award - Gulf Oil Corporation

*VARIABLE d-ELECTRON TRANSITIONS AND THE INDUCTIVE EFFECTS OF LIGANDS

Luther, Kirsten E., Ridge H.S., Basking Ridge, NJ 07920
26 William Street, Basking Ridge, NJ 07920

The purpose of this experiment was to determine whether the bis-(2,4-pentane-dionato)oxovanadium(IV) [$VO(acac)_2$] molecule is an accurate gauge of the inductive effects of para-substituted halogenated benzenes. It was expected that the energy levels of the d-orbitals of the vanadium(IV) ion would change with the donor properties of certain ligands. Agreement of these changes with an accepted ranking system of inductive effects of the para-substituents would have proven $VO(acac)_2$ an accurate gauge.

Spectra were obtained for para-substituted bromo/chlorobenzene solutions having a 10:1 ligand to $VO(acac)_2$ ratio in CH_2Cl_2. A measurement of change in the electron transitions for T^{2g} complexes, $D_{(T_{2g})}$, remained constant (@1.2kK) for all the solutions. These results may have been due to: 1)steric hindrance; 2) the ligand to $VO(acac)_2$ ratio being too low; or 3) solvent interference.

To avoid the steric hindrance problem, the spectra of para-substituted m-bromo/chlorotoluenes were studied. The ligand to $VO(acac)_2$ ratio was varied from 10:1 to 1000:1. The solvent was switched to benzene. As these variables were introduced, changes in $D_{(T_{2g})}$ were observed. These changes showed a limited relationship to the Hammett σ values of the substituents. Several substituents were used in this experiment. Those with strong electron-donating properties did have a proportional effect allowing the halogen to bond more strongly to the T^{2g} ion. The effects produced by strong electron-withdrawing substituents, however, suggested that they were bonding directly to T^{2g} rather than through the benzene. Thus, $VO(acac)_2$ may be used as a gauge of the exact inductive effects produced by bromo/chlorobenzenes with electron-donating para-substituents.

@First Award - United States Navy/Office of Naval Research
Honorable Mention - American Chemical Society

#ARTOCARPUS ALTILIS: A POSSIBLE HYDROCARBON SOURCE

Matos, María A., Our Lady of Pilar H.S., RFD), BOX 27P
Río Piedras, PR 00928; BOX 876 Guaynabo, PR 00657.

The purpose of my investigation was to see if the product (classified as rubber due to its characteristics) I discovered from the latex of the breadfruit tree, could be used as a hydrocarbon-like material that can be renewable, instead of using hydrocarbons such as petroleum, natural gas and coal which are all rising in cost and they will be exhausted.

We will be concerned with the investigation of the product and the tree, improving the knowledge about it and utilizing the product in the most useful way.

Some of the experiments I carried out were: to find a better coagulant, to find how much latex could be obtained, how long it takes and at what age. How rubber is affected by certain solvents. Some of the analysis carried out on the product were: infrared spectrometry, TLC, pure rubber content and NMR used for a comparison of the rubber with commercial rubber.

The results of my investigations and of the comparison of the rubber with the commercial rubber favour the possibility of using this product as a renewable hydrocarbon source. Other factors are: the breadfruit tree does not need great care. We can make better use of the uncultivated land in Puerto Rico and in other parts of the world. This product may be obtained all year round, and the breadfruit is very nutritious.

Artocarpus altilis plantations could be the answer to the economic situation of Puerto Rico and other parts of the world which are confronting the search for economical stability.

*Scholarship - Ohio State University
Third Award - General Motors ISEF

THE EFFECT OF HEAT ON THE HYDROLYZATION OF ASPARTAME

Ohlhausen, Esther Le Nelle, Abilene H.S., Abilene, TX 79603;
734 E N 11th, Abilene, TX 79601.

Approximately 0.3 M solutions of aspartame were prepared using 1 g aspartame (as packaged for retail sale) in enough water to make 30.0 ml of solution. The solutions were heated in a temperature-controlled oven for up to 7 days at 60° C. In those solutions which had been heated for 3 or more days, a faint brown color and a methanol odor were detected, indicating a chemical change in those solutions. Each sample was tested by paper chromatography to determine whether aspartame and/or aspartyl-l-phenylalanine were present. Because aspartame is polar, and aspartyl-l-phenylalanine is nonpolar, the aspartame molecule was expected to travel farther with the solvent (3 parts butanol, 1 part acetic acid, 1 part water). The R_f values for aspartame and aspartyl-l-phenylalanine were found to be 0.773 and 0.200, respectively. The intensity of the aspartyl-l-phenylalanine spots increased with increased exposure to heat, with a corresponding decrease in the intensity of the aspartame spots. Because the hydrolysis reaction which produces aspartyl-l-phenylalanine also produces methanol in equal concentrations, it was inferred that methanol is produced when aspartame is exposed to elevated temperatures, with the amount produced increasing with increased exposure to heat. Those samples which were prepared by dissolving aspartame in carbonated rather than distilled water contained a greater proportion of aspartyl-l-phenylalanine, suggesting that carbonic acid catalyzes the reaction.

Further tests were performed using citric acid and sodium carbonate solutions in place of the carbonated and distilled water. Both the acidic and basic solutions were expected to function as catalysts for the hydrolysis reaction.

#ELECTROCATALYTIC CONVERSION OF CARBON DIOXIDE TO OTHER CARBON COMPOUNDS

Luong, Thiem, A.A.Stagg H.S., Stockton, CA 95207;
419 E. Sonora St., Stockton, CA 95203.

The purpose of this research is to convert carbon dioxide to some fuel so as to help reduce the greenhouse effect and the energy crisis.

Two different types of electrodes, silicon and gallium arsenide, with different crystal orientations were prepared. These electrodes were used to perform many different types of experiments. Experiments with different pH's, current densities, types of electrodes, and crystal orientations were carried out to compare the amount of the product yielded when one variable was changed. A 0.2M Na_2SO_4 solution was used as the electrolyte in all of the experiments throughout the research. Some special experiments were performed to provide a better insight into the reactions, such as the electrolysis of formic acid, formaldehyde, and methanol.

Methanol was produced in many cases. It was found that the best conditions so far for producing methanol seem to be the Si(111) electrode, a current density of about 230 micro-amperes per square centimeter, 2.5V, and an electrolyte with a high initial pH. The methanol concentration produced in this sample after about six hours of electrolysis was 1×10^{-2}M. In the cases where methanol was produced, no intermediate products were found, that is, formic acid and formaldehyde. This lack of intermediates indicates a one-step reaction, from carbon dioxide to methanol, which is consistent with the mechanism proposed.

#Honorable Mention - Gulf Oil Corporation
Honorable Mention - National Aeronautics and Space Administration

EARTH AND SPACE SCIENCES

#THE EFFECTS OF ACID RAIN ON SOIL NUTRIENTS

Yim, Christina Y., Upper Dublin High School, Ft. Washington, PA 19034
669 Meadowbrook Ave., Ambler, PA 19002

Since the acid rain issue was first introduced in the 1960's, it has steadily gained the attention of environmentalists around the world. Even today, this topic is a subject of discussion between the Canadian and American governments.

This experiment's three phases were designed to determine the effects of acid rains of varying pH's on certain soil nutrients important to plants. In Phase 1 the researcher tested for manganese; in Phase 2, calcium and magnesium; in Phase 3, nitrate, phosphate, and potassium.

Artificial acid rains were permitted to leach topsoil through a system developed by the experimenter. Colorimetric testing techniques provided the method for measuring the precipitations's effects on the soil's nutrients.

The researcher hypothesized that as the pH level of the rain dropped, indicating a greater acidity, more of each nutrient would be leached from the topsoil creating a negative effect. The acid rain would solubilize the nutrients, thereby increasing the amount of each element which could be removed from the soil through the leaching process. The data collected during Phases 1 & 2 do not support the hypothesis in that the acid rains with the higher pH's and the control solutions leached more of the three nutrients than the stronger acid rains; however, the results of Phase 3, this year's experiment, confirm the stated hypothesis. The more acidic rain concentrations did leach more nitrate, phosphate, and potassium from the soil.

#Fourth Award - General Motors ISEF

#THE FIVE LIFFEYS - THE EVOLUTION OF A RIVER SYSTEM

Ross, Fionnuala, Holy Child School, Killiney, Co Dublin, Ireland
5 Brighton Terrace, Monkstown, Co Dublin

The river Liffey rises in the Wicklow mountains and makes its way to the sea through the centre of Dublin (Ireland).

Most Dubliners know the history and legends of the river spanning 5,000 years. My aim was to tell a more ancient story of the river and its wanderings. A chance reference in a book led me to search the Wicklow hills over a two year period for evidence of the dramatic changes in the river's course over the past 25 million years. I used photographs to highlight the clues where they were visible. I developed models to bring to life the secret topography where part of the story was buried beneath glacial till. These old contours could be gleaned from records of borings for wells, dams and harbour walls and I surprised Dubliners with what lay under their own city. I also used models to demonstrate what must have happened before the ice age ended 10,000 years ago.

Geological detective work often uses logic to infer from the present structures (both visible and invisible) and from similar conditions elsewhere to-day what must have happened long ago. My search was guided by the textbook criteria for river capture and glacial action.

In this manner I identified five different paths of the river since it began. In two cases I was not able to trace all the course due to the heavy cover on the central plain. The mouth of the pre-glacial river Liffey exists as a deep inlet from the sea, now clogged with glacial debris, the dredging of which could provide a deepwater harbour.

#First Award - American Association of Petroleum Geologists
Second Award - Bureau of Reclamation/U.S. Department of the Interior
Second Award - General Motors ISEF
Honorable Mention - Association for Women Geoscientists Foundation

#PHASE II: PALEOCLIMATOLOGY - SIZE VARIATIONS IN FOSSIL MARINE DIATOMS AS EVIDENCE OF OCEANIC TEMPERATURE PROFILES

Williams, Todd, Athens High School, Highway 31 North, Athens, AL 35611; 314 Hoffman Street, Athens, AL 35611.

Actinoptychus heliopelta and Glorioptychus callidus are fossil marine diatoms which occurred in the Miocene and Cretaceous periods respectively according to the U. S. Geological Survey. The scope of this research was to measure the valve diameters of specimens A. heliopelta taken from Calvert County, Maryland and G. callidus collected from Panoche Hills, California. Measurements were compared to mean diameters published in taxonomic descriptions of these species.

Measurements yielded the following results: A. heliopelta mean diameters of six-sectored—87 µm, eight-sectored—129 µm, ten-sectored—183 µm, twelve-sectored—233 µm. G. callidus mean diameters from three sites were calculated 46.2, 50.4, 50.2 µm. No specimens were found in samples from four other Panoche Hills, California sites.

In A. heliopelta there were no significant differences from published mean diameters. However, the mean diameters of G. callidus from all three samples were significantly smaller, possibly indicating warmer oceanic temperatures at these locations.

#First Award - Marine Technology Society/U.S. Naval Institute
First Award - National Aeronautics and Space Administration

ORBIT DETERMINATION OF THE MINOR PLANET ELEONORA

Al-Shabkhoun, Adil J., Detroit Country Day School
Birmingham, MI 48010
31625 Briarcliff, Franklin, MI 48025

Minor planets are large asteroids that can be photographed relatively easily with long exposures on a telescope. Three photographs of the asteroid Eleonora were taken. The asteroid and six other small stars that would be used to compute the asteroids position were located on the photo. The position of the asteroid and stars on the photograph were measured to within half a micron with a measuring engine. The position of the stars were looked up in the catalog, so by knowing their positions in the sky and on the photo, and also knowing the position of the asteroid on the photo, the asteroid's position in the sky was calculated. A three-observation Gaussian orbit determination was then performed. The calculations were programmed into a computer which worked with fourteen decimal places to insure internal accuracy.

DETERMINING SOLAR ACTIVITY THROUGH SUNSPOT AREA II

Wheeler, Brian A., Clarkston H.S., Clarkston, Ga. 30021.
1120 Gunnison Ct., Clarkston, Ga. 30021.

During the past five summers, photos of the sun have been taken at the Fernbank Science Center Observatory in Atlanta. From these photos and the subsequent calculations of sunspot areas, it was hoped that a positive correspondence between the published American Association of Variable Star Observer's (AAVSO) sunspot numbers and measured sunspot area would be found. This correlation was determined to be .8795 indicating that sunspot area is a valid indicator of solar activity and could be a viable alternative to the sunspot number index. It can further be concluded that either method well represents the level of solar activity, although no conclusion can be drawn as to which indicator is better.

#DETERMINISTIC ASPECTS OF HYDROGRAPHS

Gessler, Martina, Poudre H.S., Fort Collins, CO. 80521
3205 Shore Road, Fort Collins, CO. 80524

Two previous science fair projects resulted in a computer program which can generate rainfall watersheds containing stream patterns. This year, with the use of such watersheds, I studied discharge as a function of time in response to a rainfall. Various hydrographs resulted from such simulations. First, I compared random and uniform rainfall. Later, I also varied the duration time of the rain, and I looked into the effect of hydrograph averaging.
My project contains three basic conclusions. A hydrograph's characteristics are of geomorphic origin. The averaging of many hydrographs leads to a loss of detail during peak flow periods of rain; it should not be used to develop standard hydrographs. The process of linear superpositioning of hydrographs is not valid; peak discharges are considerably understated, and the peak arrives too late.

#Second Award - General Motors ISEF

#RELATING SEA SURFACE TEMPERATURES TO RAINFALL IN THE CARIBBEAN USING ASYMPTOTIC SINGULAR DECOMPOSITION

Ambroziak, Jeffrey R., Lake Braddock Secondary School, Burke, VA 22015
7008 Cottontail Ct., Springfield, VA 22153

The purpose of this project was to determine the extent and usefulness of the relationship of Atlantic sea surface temperature (SST) and future rainfall in the Caribbean Basin. This project was designed to serve as a pilot study to determine the feasibility of a more expanded effort to use winter SST to forecast drought in the region. The data used were SST for January on a one degree grid from 25°N to 15°S and from 30°W to 70°W from 1948 to 1972, and rainfall data by month for 11 stations on Puerto Rico.

Departures from mean SST fields were computed for each year. The ocean region was divided into 25 rectangles, each containing approximately the same number of observations for the 25 year period. This reduced the data set from 1434 to 25 data points per year, removed the noise, and eliminated the missing data problem. Asymptotic singular decomposition (ASD) was used to reduce the number of variables from 25 to 5. Multiple regression analysis was then used to relate these 5 January SST principal component values for each year to the monthly rainfall for the remainder of the year for 6 stations in Puerto Rico.

There is a significant and useful relationship between the sea surface temperatures of the Western Atlantic in January and the total rainfall in Puerto Rico for the following year. The uncertainty of the estimate of annual rainfall was reduced by more than one third which is important especially since the forecast is available almost eleven months before the end of the event. It is reasonable to assume that the relationship for Puerto Rico will extend to other Caribbean islands making forecasts possible for the entire Caribbean.

#First Award - Marine Technology Society/U.S. Naval Institute
First Award - National Oceanic and Atmospheric Administration
London International Youth Science Fortnight and Scholarship - United States Navy/Naval Ocean Research and Development Activity
Second Award - American Meterological Society
Second Award - Sigma Xi, the Scientific Research Society
Second Award - United States Air Force
Alternate to Scholarship - Ohio State University
Third Award - General Motors ISEF

NONCONVECTING SOLAR POND

Do, Thuy N., Northeast H.S., OKC., OK. 73111
2612 S.E. 51 Street OKC., OK. 73139

The purpose of this research was to investigate the relationship between the heat capacity and concentration of a water based solution. The information obtained from this research can be used to aid in further developments of solar ponds in the United States.

The chemicals used in this research were salt compound (NaCl) and metal ion ($CuSO_4$). The copper sulfate was used to increase the heat capacity of a sodium chloride saturated water based solution. It was determined that the temperature of the solution increased relative to the sodium chloride concentration. It was also determined that the copper sulfate further increased the temperature of the NaCl saturated solution.

Theoretically the temperature of the solution will rise relative to the NaCl concentration, but at the point of maximum saturation the temperature will not increase relative to any further addition of NaCl to the solution. The data obtained from this research are consistent with the theory because the temperature did increase relative to the degree of NaCl saturation.

CONDUCTING METEOROLOGICAL RESEARCH USING GRASP AND A TELECOMMUNICATIONS INTERFACE

Smith, Clifford "Lee", Williamstown High School
Northwood Terrace, Williamstown, W. Va. 26187

PROBLEM: Decreased funding of National Weather Service functions has resulted in closing over 30 NWS offices since 1982. Many cities now depend on less reliable prognostications, originated up to 150 miles away, and future funding decreases are possible. How can accurate predictions be made for these areas?
HYPOTHESIS: An automatic weather network could, without the aid of meteorologists, provide more U.S. cities with reliable forecasts based on local and regional weather data input and processed by computer.
PRODECURE: Three years of research developed a comprehensive meteorology computer program, GRASP (Graphics Related Atmospheric Synopsis Program), which includes a simulation of the North American jet stream and utilizes sensor and telephone modem inputs. Computer forecasts based on the "Checkpoint City Theory" (CCT) and "Precipitation Chances Index" (PCI), a formula for forecasting precipitation, are automatically made and updated for 91 cities (obtained via modem for compuserve Information Service) was used in testing CCT and other program aspects. Tests through April 1984 indicated an estimated program accuracy rating of 96% for a 36 hour forecast, compared to 84% accuracy for meteorologists predictions. Test results for forecasts for for up to 5 days had 75% accuracy. Various tests were devised to study program accuracy at home city and other sites.
CONCLUSIONS: GRASP, over a period of 150 days, generated more accurate forecasts than did humans for all prognostication areas and with no used input. A fully automatic network could be implemented to meet current and future needs with the addition of oceanic sensors for coastal areas.

#Honorable Mention - National Oceanic and Atmospheric Administration

GALSTRUCT: A STUDY ON THE EVOLUTION OF GALACTIC STRUCTURES

Tolbert, Matthew B., Manheim Township H.S., Lancaster, PA 17601
56 Northview Drive, Lancaster, PA 17601

Project Purpose: to determine if galaxies, classified as either spiral, elliptical, or irregular structures, have evolved during the past 15 billion years. Project Procedure: The Galstruct Project is based upon the principles of Hubble's law concerning redshift velocities and distances of galaxies. For example, a galaxy with a large redshift will be farther away than a galaxy with a small redshift. Also, the greater the distance, the further back in time we see into the cosmos. From spectroscopic photographic plates made by the Mount Palomar Observatory, redshift velocities for nearly 1000 galaxies were recorded and entered into a computer designed to store large quantities of information. A computer program then divided each galaxy into 24 celestial sky quadrants. Galactic structures from each quadrant were then sorted from lowest to highest redshifts, the results projected on a printout that displays any noticeable change in structure. Research, programming, accumulating information, and analyzing results took 7 months to complete. Results: In three heavily populated quadrants (C2, C4, D2), a definite shift from elliptical to spiral galaxy structures as redshift distances increased was observed. Similar shifts, although to a lesser extent, were also evident in six other quadrants. Conclusion: Data from this project points to galaxies evolving from spiral to elliptical structures over a period of fifteen billion years. This may be caused in part by the rapid dispersion of matter in the universe, making gas and dust particle interaction increasingly improbable in space. This theory is confirmed by the fact that elliptical galaxies are known to have a smaller average mass than spiral galaxies.

#CYAMOPSIS TETRAGONOLOBA RELEASE OF CRUDE FROM VARIOUS TAR SANDS

Stitt, Shanna, Weber H.S., Ogden, Utah 84404
325 East 2550 North #15, Ogden, Utah 84404

Oil reserves presently trapped in dry oil wells, shale oil and tar sands are essential to the development of future energy supplies for our country. Present attempts to recover oil from these petroleum laden stratas has proven costly and inefficient. I have attempted to investigate an alternative means of recovery. Specifically, I investigated the problem.

My hypothesis, If guar bean slurry extracts crude oil droplets from various tar sands using heat and pressure treatments, then it is an economically fissable method of extract.

Does guar bean slurry release microscopic crude droplets found in various tar sands which have been subjected to head and pressure?

The economics of oil recovery could possibly be enhanced by using guar bean slurry in the extraction process.

Guar bean slurry has found a broad range of application in the production of petroleum. If the water-oil ratio is greater than 20:1 the well is uneconomical. This usually occurs after one-fifth to one-third of the oil remaining after primary production has been removed. By increasing the resistance to the flow of water relative to that of the oil recovered by 50-100% over that which would have been realized with water alone.

#First Award - Eastman Kodak Company
First Award - General Motors Corporation
First Award - United States Air Force
First Award - United States Army
Third Award - American Association of Petroleum Geologists
Third Award - General Motors ISEF
Honorable Mention - Gulf Oil Corporation

#RELATIONSHIPS OF THE MICROSCOPIC AND LITHOTYPIC MAKE-UP OF COALS TO THEIR BTU VALUES

Torgerson, Troy R., Carbon H.S., Price, UT 84501
950 North 300 East, Price, UT 84501

This study began by analyzing the Macerals, or microscopic make-up of different coals. This was done by first grinding the coal to a 40 mesh size, and then placing the powder into a resin. This created a pellet that could then be studied under a microscope. The macerals were then identified and photographed by the investigator on a Leitz Ortholux II microscope at the Utah Geological and Mineral Survey. The microscope used an oil immersion technique at a magnification of 500x.

Coal samples were then obtained from several mines around the Carbon County area of Utah. These samples were then polished by hand so the Lithotypes could be identified. In the Wilberg Mine, in particular, it was found that all four Lithotypes are well represented.

BTU values were then determined for the coals from the different mines, as well as each individual Lithotype. These tests were run on an Oxygen Bomb Calorimeter, and when this is used, a wide variety of "raw data" is obtained, and these different types of data must be plugged into equations to obtain the final BTU value. Since this is the case, a computer program was written to calculate these values from the data obtained.

The Maceral types and Lithotypes were then compared to the average BTU values and conclusions were drawn, as to the relationships between these different physical and chemical properties.

#Fourth Award - General Motors ISEF
Honorable Mention - Gulf Oil Corporation

#STUDY OF THE SOLAR ACTIVITY AND THE RELATIONSHIP BETWEEN THE SOLAR FLARES AND THE SUNSPOTS

Alfonso Sosa, Edwin CROSS High School Box 1550 Mayaguez, P.R. 00709 Barrio Cocos Buzon C-212-1 Quebradillas, P.R. 00742

My investigations theme is the study of the solar activity, limiting myself to only two aspects of it. The prime object is to search a direct relation between the sunspots and the flares. What I am trying to say is that the higher the number of sunspots, the higher will be the number of flares. To prove the relationship between both phenomenous I used data supplied by the Solar Observatory at Ramey Base, Aguadilla. With that information I made some correlation graphs to demonstrate a relation between the number of sunspots in the group and the number of flare that were produced. Once the results were obtained we can observe that the correlation index is somewhat low and it can't sustain a clear relation, so I divided the sunspot groups in their magnetic classification. In this way, it could be seen that there was a relationship between the type of spots and the quantity of flare that were produced. For the flare study I limited myself only to record radio waves using some kind of home made radiotelescope constructed by myself. As for the study of the sunspots I decided to make daily photos, I daily determined the size and the location of the sunspots in heliographic degrees, and the degree of inclination and the rotation time of the sun.

#First Award - Bushnell Division of Bausch & Lomb
Third Award - Society of Photographic Scientists and Engineers

#THE GEOLOGY OF CONANICUT ISLAND

Hoyas, John J., Lincoln Jr.-Sr. High School, Lincoln, RI 02865
11 Laurel Lane, Lincoln, RI 02865

The purpose of this study is to identify and to map the varied rock formations seen along the coast of Conanicut Island, Rhode Island (Beavertail). Beavertail was chosen for the topic area for several reasons. First, the island is unique in the diversity of rock types which are found in a comparatively small area. Second, the layer of topsoil along the coast has been stripped off by glaciation and by sea action. Lastly, the project has considerable promise for further development. Moreover, the bedrock is, in some cases, as old as the Pre-Cambrian Age and has been shown to contain trilobite fossils.

The procedures used in the identification of rocks were the Archimedes density calculation which does not damage samples; basic observation of physical characteristics, such as impact, weathering effects, cleavage, or fracture; and the Mohs hardness test. The outline of the map was prepared by projecting a slide of a standard map onto paper. Data was drawn from two experimental procedures. The first was field drawing which showed the precise shape of the coast. Geographically accurate data was then obtained by using a sextant built for this purpose in order to demonstrate the actual shape of the island. Thus, triangulation allowed charted landmarks, such as water towers, to assist in clarifying coastal positions from which readings had been taken. Photography was an integral part of the process in that it illustrated geologic transitions too gradual or too grand to be represented by a sample. The results corroborated the hypothesis that the island had undergone considerable pressing and heating by the earth. Many rocks formed by similar processes differ only because of divergences in the metamophic process.

#Fourth Award - American Association of Petroleum Geologists

"PLATE TECTONICS AND THE DYNAMICS OF LITHOSPHERIC PLATE MOVEMENT"

De Leon, Ramon
Albert G. Lane Technical High School, Chicago, Illinois 60618
1722 N. Hermitage Avenue, Chicago, Illinois 60622

The purpose of this investigation is to explain the occurrence of volcanoes, earthquakes, mountain belts, faults, and certain mineral deposits as being the result of the collision of lithospheric plates. Such relationships show that it is possible to determine the future continental configurations, and the location of mineral deposits by their tectonic setting.

The location of various volcanoes and earthquakes were plotted on a map by latitude and longitude, then correlated with the location of plate boundaries (spreading centers, subduction zones, and transform faults). In addition the location of certain mineral deposits and their tectonic setting were analyzed. Lithospheric plate spreading rates were calculated by dividing the distance from the ridge axis by the corresponding age of the oceanic crust.

An analysis of the plotted data shows that earthquakes and volcanoes occur at or near plate boundaries. From the determination of the spreading rates it was possible to illustrate past continental configurations. A study of the distribution of mineral deposits suggests that they are restricted to certain tectonic settings.

It was concluded that there is a direct correlation between plate boundaries and the location of earthquake, volcanoes, transform fault, and certain mineral deposits. It was possible to calculate lithospheric plate spreading rates by knowing the age of the oceanic crust and distances involved. From this, the future configurations of the lithospheric plates were determined, and by knowing the tectonic setting in which a mineral deposit was formed it has been shown that similar deposits can be found at equivalent location.

#Fifth Award - American Association of Petroleum Geologists
Alternate Award - Society of Exploration Geophysicists

FERTILIZING EFFECT OF NINE DIFFERENT PLANTS IN SIX DIFFERENT SOILS

López, Lyzbette, Santo Domingo Junior High School, Peñuelas, Puerto Rico 00724
Bo. Macaná, Apt. 475, Guayanilla, Puerto Rico 00656

This investigation is based on the study of six different types of soil (white sand, black sand, tuff, fertile ground, coarse sand and fine dust) in which seeds of Phaseolus vulgaris were planted and sprayed daily with ten mililiters of the extract of three marine algae (Ulva lactuca, Fucus evanescens and Lyngbya majúscula), three river plants (Cyperus alternifolius gracilis, Commelina diffusa and Cleome spinosa), and three terrestrial plants (Pluchea symphytifolia, Cereus hexagonus and Peperomia pellucida). Growth was measured and the development was constantly observe, which measurements were recorded in tables and graphs. The purpose of this was to find out which of the extracts used was the best one as a fertilizer for the different soils mentioned above in the development of Phaseolus vulgaris.

According to the data obtained it was concluded that the seeds germinated and developed better in white sand the extracts producing the best results were the ones from Lyngbya majuscula, Pluchea symphytifolia and Cleome spinosa.

In the near future, this investigation will be continued with other seeds adding the extracts of other plants and using other types of soil.

#WAVELENGTH MEASURING AND IMAGE PROCESSING WITH AN ABC 806-MICROCOMPUTER

Berg, Peter, Vasaskolan, 803 52 Gävle, Sweden;
Pinnmovägen 14, 803 60 Gävle, Sweden

"A picture tells you more than a thousand words" - so goes the saying. However, a picture can tell us even more if we do not only watch it with our own eyes. Advanced research is carried out into the treatment of the data inherent in a picture in order to obtain the largest possible amount of information.

Image processing with the help of computers is already being used in many fields in both research and industry, for instance on astronomical photographs in order to bring out the contrast, reduce noise or otherwise make the image easier to interpret.

Initially, the aim of my project was to define the wavelengths of the absorption lines in the solar spectrum with greater accuracy than I had been able to obtain through manual measuring. In order to do this I scan a photograph of part of the spectrum using a laser beam, a photo-transistor and a computer. However, the project developed and now includes scanning of a whole picture and some basic processing routines.

An appropriate photograph is scanned in a home-made scanner, whereupon the information is treated in an ABC 806-microcomputer. I can present the picture two- or three-dimensionally, reduce noise, bring out the contrast, show various intensities of light in 16 different colours and study the distribution of the intensity values of the pixels.

#First Award - Eastman Kodak Company
First Award - General Motors Corporation
First Award - General Motors ISEF
First Award - Society of Photographic Scientists and Engineers
Alternate to Scholarship - Ohio State University
Honorable Mention - United States Army

AUTOMATION OF THE "VSA"

Shawn Bishop, Ft. Sumner H.S., Ft. Sumner NM 88119
Ave. E, Box 615, Ft. Sumner NM 88119

After four years of progress, the "VSA" has become automated both in data acquisition as well as remote movement through use of a computer. This was accomplished by using an analog to digital-digital to analog converter.

Data was taken from 60 degrees south of the Zenith to 20 degrees north of the Zenith.

In order to perform an observation, the antenna was aligned in the desired declination. Then, the natural rotation of the earth moved the antenna past the celestial sky.

According to the test data, 43 sources were detected. Seven of these were detected more than once. Eleven of these were previously observed by other radio astronomers.

The antenna mounting has raised the total height to 33 feet and is motorized to be controlled by computer, therefore placing all operations within a centralized control point.

It was only shortly after solving the multitude of problems to make the system fully operational that a major wind storm delayed further research because the antenna was blown down. Therefore a new antenna has been constructed much like the previous antenna except for a few minor changes.

"HIROSHIMA GRANITIC ROCK" IN THE SOUTHERN AREA OF MIHARA HIROSHIMA PREFECTURE, JAPAN

Nishimoto, Shoji, Mihara Higashi H.S., Mihara-shi, Hiroshima 723;
4376-1 Nakano-cho, Mihara-shi, Hiroshima 723, Japan

In order to make a precise geological map of the southern area of Mihara, Hiroshima Prefecture, I studied "Hiroshima Granitic Rocks" of the LATE MESOZOIC ERA widely distributed in that area.

Based on field study and research of the petrographical characteristics, I have classified them into four rock bodies, which I named as follows.

(1) TADANOUMI ROCK BODY
(2) HONGO ROCK BODY — Subclassification: (a) MAIN ROCK FACIES (b) SUBORDINATE ROCK FACIES
(3) KOIZUMI ROCK BODY — Subclassification: (a) COARSE-GRAINED FACIES (b) FINE-GRAINED FACIES
(4) MITSUDANI ROCK BODY

By observing the intrusional relationships among the above-mentioned rock bodies, I found out that the MITSUDANI ROCK BODY is the oldest and the KOIZUMI ROCK BODY follows. I have not as yet positioned the TADANOUMI ROCK BODY and the HONGO ROCK BODY.

The characteristics of each rock body:

(1) TADANOUMI ROCK BODY: The QUARTZ-POOL is underdeveloped. A lot of QUARTZ VEINS are developed on the fringes of this rock body. (2) HONGO ROCK BODY: The MAIN ROCK FACIES include MAFIC MINERALS often as CLOTTED AGGREGATES. QUARTZ in this rock body is recognized as a textural unit called a POOL and there are a lot of cracks. The SUBORDINATE ROCK FACIES include only HORNBLENDE as a MAFIC MINERAL. (3) KOIZUMI ROCK BODY: Characterized by an abundance of pink POTASH FELDSPER. (4) MITSUDANI ROCK BODY: Fine-grained TONALITE.

#Fourth Award - General Motors ISEF

THE EFFECTS OF ULTRA-VIOLET RADIATION AND MAGNETISM ON DROSOPHILA

Stewart, Jennifer, Luverne H.S., Luverne, MN 56156;
P.O. Box 152, Luverne, MN 56156.

The purpose was to determine if magnetism alters the way radiation affects living systems. Also, this experiment was devised to determine if there is a synergistic effect between these forces.

*Magnetic fields were devised by using bar magnets. The magnets were set up so the Drosophila would be exposed to like and opposite poles.

The cultures consisted of ten sepia females and males. The cultures and their magnetic fields were then placed in an incubator with a temperature of 27° C.

After four generations were raised in a magnetic field, the experimental offspring were placed under U.V. radiation.

Controls were used to make comparisons.

*Drosophila in the SS magnetic field had a higher birth rate than the control. Drosophila in the NS field had a much lower birth rate than the control. Drosophila in the NN field did well at first, but then declined. In all the experimental cultures the birth rate was in favor of females.

When U.V. radiation was added, Drosophila in the SS field continued to flourish while Drosophila in the NN field had a slightly higher mortality rate and Drosophila in the NS field had a much higher mortality rate. Drosophila who had little or no exposure to magnetism soon died after being exposed to the radiation. Contrary to previous data, the males had a higher survival rate.

In conclusion, it seems that magnetism lessened the severity of the damage inflicted by the U.V. radiation.

*All data not listed.

#First Award - United States Navy/Office of Naval Research

THE GENERATION OF ELECTRICITY FROM THE MOTION OF WAVES

Erb, Stephen C., Hudson H.S., Hudson, FL 33562;
12231 Bear Claw Loop, Bayonet Point, FL 33567.

The purpose of this project was to design, engineer, and construct operational small scale electric generating models of possible future power plants. These plants operate by transferring the waves' mechanical energy into a more applicable force - electric current.

After constructing the four models, I put them into operation in the Gulf of Mexico. On ten various days of sufficient wave action, I measured and recorded the actual voltage output of each model. I also measured and recorded wave amplitude, wavelength, water temperature, and water depth to see their singular and combined effects on the output and performance of each model.

Out of the four models I tested, the Ratchet Driven model, which operates with an action similar to a piston, had the highest average output of 55 volts. Second best was the Lever Driven model which had an average output of 45 volts. This model has the seemingly best design as it uses the waves' horizontal motion as well as the vertical. The Gear Driven model came in third with an average output of 40 volts. Last is the Air Driven Model with a design quite different from that of the other models. The design seems logical but a problem arrises in the fact that this model operates by forcing air through turbines. Air is a compressible medium so the model wasn't maximizing its output.

I noted numerous engineering flaws in the construction of these models as a result of the limited supplies and equipment available to me. In all likelihood, a higher output could be achieved through better engineering and design. I believe the greatest application of this project is the use of wave energy as a feasible alternative to fossil fuels. The big question lies in the cost effectiveness of these models.

PHOTOMETRIC ANALYSIS OF BETA PERSEI

O'Brien, Darin P., Stuart-Menlo Community School, Stuart, Ia. 50250
318 N. Harlan, Stuart, Iowa 50250

The purpose of my project was to determine the light curve of an eclipsing binary star system. In such a system, a periodic fluctuation of brightness occurs due to the eclipsing of one star by another. The star I observed, Beta Persei, is known for its large change in magnitude due to this phenomenon and is often used as a test star. Before I could actually make observations of the star, I had to devise a way to make an accurate reading of the intensity of the star. This was done by constructing a photometer. This photometer was built to adapt to an 8-in. Schmidt-Cassegrain telescope. The telescope used had to be of sufficient aperture to have the light gathering capability to make an accurate reading of the light. The photometer was constructed mainly of plywood and aluminum and consisted of an aperture wheel, a relay lens system, an eyepiece, and a photomultiplier tube. The aperture wheel was used to block out light from sources other than the star. The relay lens system and eyepiece were used to make sure the correct star was in the aperture before an observation was made. The photomultiplier tube was then used to convert an intensity of light to a proportional voltage. When making observations I would make a reading of the variable star, the surrounding sky, a reference star, and the sky surrounding it. To take into account changing atmospheric conditions, the sky readings were then subtracted from the star readings. This is because readings made from the stars also consist of light from the back-ground which may change rapidly without notice. A simple algorithm, derived from the Pogson magnitude scale, was then used to find the magnitude difference between the variable star and the reference star. This differential magnitude is then plotted over time to determine the light curve.

SNOW CRYSTALS: A COMPARATIVE ANALYSIS

Phillips, Tom, J.K. Mullen High School, Denver, Co., 80236
5583 S. Moore St., Littleton, Co., 80127

The purpose of my research project was to determine what factors affect the growth and structure of snow crystals.
Hypothesis I: The size, shape, and crystaline formation of a snow crystal has a direct relationship to the water content and the temperature of the air.
Hypothesis II: Different nuclei with different threshold freezing points will create different crystaline formations.
Hypothesis III: The pH of the water content of a snow crystal will affect its growth and structure.
A chamber to grow snow crystals was constructed and 15 compounds were used as nuclei to grow snow crystals with a pH of 6.2, 7.2, and 8.2. Field research consisted of collecting and replicating on slides, snow crystals at various locations and elevations. Crystals were microscopically analyzed and photographed. Different chemical compounds had different threshold temperatures at which crystals formed. The type of snow crystal that forms is dependent on the amount of water in the air and the temperature at which the water molecule nucleates. Different nuclei will form different crystaline shapes and freeze at different threshold temperatures. The pH of the water content of the air had an effect on the threshold temperature at which the crystal formed.

#First Award - American Meteorological Society
First Award - Eastman Kodak Company
Third Award - General Motors ISEF
Honorable Mention - Association for Women Geoscientists Foundation

#A COMPARATIVE PERFORMANCE OF GASOLINE FUEL EXTENDERS IN AUTOMOBILE ENGINE TESTING: PHASE II

Bowman, Markus P., Melbourne H.S., Melbourne, FL 32901
8637 Sylvan Dr., Melbourne, FL 32901

Currently, Ethanol and Methanol are the only two gasoline extenders on the market. Both of these products are currently prepared from feedstuffs, mainly sugar and/or corn. Therefore, the effect of converting sugar or corn into Methanol and Ethanol is to raise the price of the sugar and corn.

An ideal gasoline extender should have a waste feedstock practically unfit for anything else, and the capitalization costs should be minimal in these days of high interst rates. Furfural and Levulinic acid are two such products. Furfural can be converted into Tetrahydrofuran, and Levulinic acid can be converted into Methyl Ethyl Ketone, Methyltetrahydrofuran, and Angelica Lactone.

In Phase I of testing, these fuels, along with Methanol, Ethanol, Isopropyl Alcohol, regular gasoline and unleaded gasoline were tested in laboratory conditions on a test engine to determine feasibility and fuel economy.

Phase II of experimentation was concerned with how a typical passenger automobile performs with the actual test fuels. While Phase I dealt almost entirely with fuel economy, Phase II also dealt with changes in oil viscosity, engine temperature and oil pressure, acceleration, driving characteristics and fuel economy.

#Alternate to Scholarship - United States Navy
Fourth Award - General Motors ISEF

GREAT SALT LAKE - VARIATION IN SALINITY & EVAPORATION

Smith, Debbie D., Roy High School, Roy, Utah 84067
1742 West 4575 South, Roy, Utah 84067

This project deals with sodium chloride's effect on the rate of evaporation on each arm of the Great Salt Lake which is separated by a rock-filled causeway.

Samples from each arm of the Great Salt Lake were taken to observe the contrasting evaporation rates in the north and south arms of the lake. The rates in the two arms varied due to existing differences in salinities. The different rates of evaporation present during summer months were calculated.

From the samples of each arm, the salt content was determined by completely evaporating the samples. The remaining salt was weighed to calculate the salt content for each arm of the lake.

Using data available, a constant for each arm was mathematically determined to calculate vapor pressure in each arm for specific temperatures.

For my fourth experiment, I wanted to simulate the lake's natural process of evaporation in replacing evaporated water with additional water to maintain the same general water level. An apparatus duplicated the salinity at each arm and measurements were made of the differing rates of evaporation at the north and south arms.

These experiments show notable differences in the salinity, vapor pressure, and rates of evaporation in the North Arm and South Arm of the Great Salt Lake which could be significantly altered by possible breaching of the causeway.

LIFE ON JUPITER?

Pealer, Donald D., Cumberland Valley H.S., Mechanicsburg, PA 17055
3720 Trindle Road, Camp Hill, PA 17011

The objective was to determine whether life, as amino acids, could be formed within the atmosphere of Jupiter. To answer this objective, a Miller-Urey like environment was constructed, which contained an adapter system that was airtight secure to atmospheric constituents gas tank, mercurial barometer system, and vacuum-sample system. The environment also contained two mounted tungsten rods that were connected to a transformer; this simulated the lightning discharges detected within Jupiter. The environment was then sterilized by ethyl alcohol and oven baking at 505° degrees Kelvin for seven hours. In addition, the environment's series of trials were conducted at one atmosphere with a temperature of 300° degrees Kelvin, since it was based upon the structural model of the Jovian atmosphere. After vacuuming the environment, the atmospheric constituents were introduced into the environment and the simulation of lightning discharges was initiated for a period of seven days. Upon completion of this time period, liquid samples were withdrawn from the environment and tested for the presence of amino acids. This was accomplished through two-way and gas chromatography procedures, which resulted in the formation of Rh values and graph comparisons. These values and graphs were compared to previously done twenty amino acids that went through the same process. The result of the comparison was the detection of several amino acids, which suggests that life, as amino acids, may exist within the Jovian atmosphere. However, it suggests that such a formation is not only occurring within Jupiter, but throughout the universe.

#First Award - Vacuum Technology Division of the American Vacuum Society

THE EFFECTS OF GEOMETRIC SURFACE VARIATIONS ON THE EFFICIENCY OF SOLAR COLLECTORS INCLUDING SIMPLE AND COMPOUND PARABOLIC CONCENTRATORS

Burger, Brian T., Marianna H.S., Marianna, FL 32446
280 Shankle Drive, Marianna, FL 32446

This project investigates changes to solar collector efficiency caused by varying the shape of the collector's surface. It applies the principles of solar energy absorbtion covered in previous years' science projects as well as some basic principles of plane geometry to see if there are any alternatives to the traditional flat-plate collection methods for home use.

Three variations were constructed...a waffle steel collector using mirrors to direct sunshine, a simple parabolic concentrator, (U shaped), and a compound parabolic concentrator (W shaped). A flat-plate collector was also used as a control.

Temperature readings were recorded on January 28, 29, 30, and 31 for the fixed 42° tilt angle, fixed position (due south) test, and for the test where solar altitude and azimuth angles were varied to follow the sun's path through the sky.

All three variations performed better than the flat-plate collector with the simple parabolic concentrator recording teadings 16% and 33% higher than the flat-plate for the fixed and variable tests, respectively.

The results prove that there are alternatives to flat-plate solar collection.

#THE USE OF HOME COMPUTERS IN FORECASTING THE WEATHER

Link, Lisa A., Edgewood H.S., Ellettsville, IN 47429;
213 Western Dr., Bloomington, In 47401

With today's world of high speed computers, the accuracy of weather forecasts have been increased immensely. Still, some individuals have had a difficult time acquiring an accurate local weather forecast. Therefore, the purpose of this project was to write a computer program in the BASIC language that would accurately forecast the weather for a localized area.

Before writing this program, I first studied local weather conditions intensely for a two week period. In addition to using information gained from this study, I also used valuable information from previous weather studies from 1980 and 1981. I then analyzed all of this data and noted similarities between combinations of weather readings and the resulting weather. I molded these similarities into broad weather statements that described a particular weather condition. Next, I programed an ATARI 800 computer to categorize inputted weather data into one of these generalized statements and consequently print the appropriate 24-hour forecast. I then revised this program by testing the accuracy of its forecasts against data acquired from a weather study of August 1981.

Once the program was completed, I compared the accuracy of its forecasts to that of two local newspaper's forecasts. I found that the computer had an accuracy of 88.24% and that the majority of its forecasts were more specific and detailed than that of the two newspapers.

As a result of this project, anyone with a limited knowledge of meteorology can use this program to acquire an accurate local weather forecast.

#Second Award - National Oceanic and Atmospheric Administration
Third Award - American Meteorological Society
Honorable Mention - United States Air Force

#SOIL ANALYSIS

Anderson, Rexann, Lutcher H.S., Lutcher, LA 70071;
P.O. Box 230, Gramercy, LA 70052.

The purpose of my project is to examine and compare various aspects of the farming soils on the east bank of the Mississippi River in St. James Parish, Louisiana, in order to obtain a complete soil analysis by conducting several experiments on samples taken throughout the area. To do this, I collected 26 soil samples from twelve major regions of the parish. (21 of these samples were gathered from farm land which yields sugarcane. The other 5 samples came from truck farms.) I estimated the soil type and measure of acidity (pH) for each sample. I then proceeded to calculate the cation exchange capacity which is the measure of the total amount of exchangeable cations that can be held in the soil. By using the calculations and pH value, I estimated the Percent Base Saturation for each sample. Last, I made a microscopic examination of each soil sample in order to make an inspection of soil microflora. From this information, I could obtain my soil analysis. I compared my results to make an overall analysis as well as independent and soil growth analysis for the farming soils on the east bank of St. James Parish. Most of the farming soils tested were used in production of sugarcane. Therefore, I made logical statements to prove the soils capability of growing this crop. This was also done for those samples which came from truck farms.

#First Award - Association for Women Geoscientists Foundation

ENGINEERING

A COMPUTER CONTROLLED PARABOLIC SOLAR COLLECTOR

Calfee, Gary, Burkburnett High School, Burkburnett, Texas, 76306;
2310 Perrin, Wichita Falls, Texas 76306

It has been previously concluded that to produce an efficient parabolic solar collector a tracking system must be present. The intent of this project is to produce a parabolic solar collector that will track the sun by means of motor control by a Commodore home computer and interfacing circutry.

A small parabolic trough collector with horizontal and vertical position controlled by two small D.C. motors was constructed. After investigating the user port circutry of the Commodore 64 home computer, a compatable interfacing device was designed and constructed. A program was then written which utilizes algebraic formulas that calculate the apparent position of the sun for any given date, time, and location within the continental United States. It was concluded that a home computer can be utilized to control a motor driven parabolic solar collector.

#ADVANCED LOW SPEED WIND TURBINE

Zigan, Mike J., South Ripley H.S., Versailles, IN 47042
Rte. 1 Box 235, Versailles, IN 47042

My purpose was to design and construct an efficient wind turbine for the home owner at low cost using simple construction methods. Previous science fair projects have provided me with useful information and experience in blade construction and the basics of wind turbine aerodynamics. I added this to my interest in flying and computers to study in detail the use of different airfoils and blade planforms to develop an efficient wind turbine. As design parameters I wanted it to have fixed pitch blades and operate in low eight to ten m.p.h. winds. After studying research materials gained through interviews with NASA aerodynamisists and books on wind turbine design, I studied several airfoils and their pressure distributions on a computer. With this information I chose the most promising airfoils and constructed several wind turbines. I then experimented with these turbines to determine and compare their qualities in starting torque, rotational speed, and the use of tip fences through varying degrees of angle of attack. With this experimental data to compare to my hypothesis, I was then able to form my conclusions. The computer program available to me gave only two dimensional data, however, it did give me valuable information on several airfoils and their pressure distributions, which allowed me to study many airfoils without having to spend a lot of valuable time in the construction of unuseable wind turbine blades. This computer innovation along with my innovations in composite construction helped me to design and build a fixed pitch, light weight, and efficient wind turbine using simple construction methods at low cost. I now plan to use this information and experience to build a full scale wind turbine for further research and testing on our farm.

#Fourth Award - General Motors ISEF

#PHONEME ENGINEERED SOLID STATE SPEECH

Nielsen, Bradley A., Taylorville H. S., Taylorville, IL 62568
R. R. #1, Box 254B, Taylorville, IL 62568

My purpose for this project was to research the three different types of speech synthesizers and to incorporate one of these into a text-to-speech synthesizer that would automatically pronounce sentences that are typed on its keyboard.

I began constructing the text-to-speech synthesizer by first building a 8085 microcomputer, which would be used as a controller in the project. I then designed and constructed additional circuitry that is used to operate the keyboard, displays, data memory, and the speech synthesizer. After correcting minor difficulties in the microcomputer and support hardware, I then wrote the master program for the compiler and programmed a small pronunciation list.

The text-to-speech synthesizer is now able to electronically pronounce words that are typed on its keyboard. This is done by incorporating a phoneme synthesizer, which was chosen because of its unlimited vocabulary. Because of the versatility of the compiler, I will be able to use this component for other future functions. These may include an E^2PROM programmer with only a change in software. This project has increased my knowledge of the various types of speech synthesis as well as my knowledge of the 8085 microcomputer system.

#First Award - Ohio Bell Telephone Company
Fourth Award - General Motors ISEF

THE FEASIBILITY OF CIRCULAR WINGS ON AIRCRAFT

Swami, Jay K., Valley H.S., Smithers, WV 25186
Box 21, Montgomery, WV 25136

The purpose of this project was to determine the feasibility of using a circular wing configuration on aircraft by investigating the theory behind the circular airfoil, and by examining the performance characteristics of the circular wing on various models in the field and in the laboratory. First, I did some research into the theory and principles of flight. I found that there was no theory or data on the circular wing. Using a balsa wood rod and semi-cardboard paper I built different models with various numbers and types of circular airfoils. The configuration that worked best was one airfoil in front and a larger one in the back. Using this configuration as a standard, I built models with wings of different diameters and widths. I tested these models to measure average speed, distance flown, duration of flight, and to observe the mean altitude, flight patterns, and other performance characteristics. The results of my investigation showed that the circular airfoil performed well. A significant amount of lift was generated. Some of the models consistently flew over 50 feet (15.2 metres). There was a direct relation between the lift to weight ratio of the wing and the distance flown. The circular wing exhibited a very high level of stability due to the low moment (distance x weight) of wing. I calculated the lift area of the circular airfoil and derived a formula for the lift surface area. I observed a tilt from the direction of flight in the models, which is probably caused by the differential lifts, weights, and drag forces. This tilt created a greater angle of attack which increases the amount of lift produced. My conclusion is that the circular aircraft wing is a feasible concept with great potential for application, especially on large aircraft.

HOW CAN HYDROGEN BE USED FOR WATER TRANSPORTATION

Rider, Todd Harrison
Ole Main High School, North Little Rock, AR
501 West "A" Street, North Little Rock, AR 72116

Because hydrogen comprises just 1/9 of the total weight of water, decomposing water into the gas would greatly reduce the weight involved in transportation. When burned in air, the hydrogen would combine with oxygen to form water again.

To insure that the hydrogen would not combine with the air's nitrogen to produce poisonous ammonia, two hydrogen-burning devices were built. They showed no traces of ammonia in water produced from hydrogen and air.

One application utilizes hydrogen blimps to transport water to dry areas. Each 1,800 foot blimp would produce over one million gallons of drinking water, enough to support 20,000 people for four months. Using jetstream winds, the blimps could fly over 5,000 miles from a hydrogen manufacturing plant to their destination, where the hydrogen would be burned in a remixing plant.

Another way to transport the hydrogen is by a pipeline connecting a hydrogen plant on the coast and a remixing station in the area of need. The gas could be pumped more efficiently than water.

Still another method is to strip the electrons from the hydrogen, forming a canal (proton) beam. Using a satellite, the beam could be transmitted to the target area, where it would be intercepted and passed through a cathode (electron) beam to form hydrogen again, which could produce water.

One final application is to construct a "high-yield" canteen from a metal hydride, such as titanium hydride. The canteen would produce more water than could be stored in a container of the same size, and could be recharged with more hydrogen.

METHANE PRODUCTION IN A HOME-SIZED DIGESTOR USING COW MANURE AND A STUDY OF THE MICROBIAL INTERMEDIARY METABOLISM IN ANAEROBIC DIGESTION

Cintrón, Vivian, Colegio San Antonio Abad, Humacao, P. R. 00661;
P.O. Box 8945, Humacao, P. R. 00661.

The production of complementary energy to substitute for coal and petroleum, which are so limited and non-renewable, contitues one of the greatest concerns during these "Energy Crisi. Days".

A new source of energy that can help solve this crisis is the Biogas produced in an anaerobic digestor, rudimentary enough to be usable in a home. The digestor is a closed tank to which you introduce Biodegradable material at intervals producing volatile substances and weak acids. Temperature, pH and rate of introduction of biodegradables are important variables. The decomposition is a four-step process by several anaerobic bacteria.

The digestor has five openings fitted with tubes of different sizes. This is fed at specific times. The same amount deposited is eliminated as residue through a pipe located at the bottom of the biomass in the tank. The whole decomposition process takes from two weeks to a month.

Chromatographic analysis and anaerobic study indicated that methane gas and carbon dioxide were produced using cow manure as biomass. The results of physiological and biochemical experiments are presented in order to explain the fundamentals of mixed culture metabolism and to identify key control parameters which influence the rate of organic degradation, the yield of reduced metabolities, and thermodynamic efficiency in the anaerobic digestion process.

Through this rudimentary technique methane gas produced in a simple apparatus can be used for stoves, automobiles and production of electricity and cause a great improvement in the energy panorama. The residuum product from the digested manure can be used as a valuable fertilizer.

Identification of mathanogenic bacteria, the mechanism of the process, the manner in which pH, temperature and additives influence the process are not well understood. My study tries to investigate some of these problems.

#Third Award - General Motors ISEF

SOLAR ENERGY SYSTEM FOR THE PRODUCTION OF POTABLE WATER AND ELECTRICITY

Zorrilla, José J., University Gardens H.S., Río Piedras, P.R. 00927
22nd. St., #330, Villa Nevárez, Río Piedras, P. R. 00927

In this project the sun rays were utilized to create a solar generator of potable water. In essence, the system uses the solar rays to increase the temperature of the water and to accelerate the evaporation process, capturing and controlling the water vapor, condensing it, and transforming it into pure not contaminated, drinkable water and at the same time power an electricity generator to produce electricity. It was expected that the system would work since the process takes place without interruption every 24 hours. Results of the investigation were very encouraging, since the thermic accelerator alm st triplicated the normal evaporation of 5.8 liter of water per M^2 of surface to 14.55 liters of water per M^2 of water surface. If out of the 14.55 liters, two third of this vapor could be condensed, the net result would be 10L of water per M^2 of surface. It is estimated that if a surface, the size of a football field, could be brought and controlled under this system, it would produce in a 24 hour period approximately 109,480 liters or 28,962 gallons of pure water. All those nations suffering of yearly drought and close to big salt water bodies would benefit tremendously with this system. Many areas of the Sahara could be made fertile and productive.

A HYBRID-FUEL ROCKET ENGINE

Conan Davis, Zia Junior High School, Las Cruces NM 88001
5818 Lassiter Rd., Las Cruces NM 88001

Conventional rocket engines have used liquid-liquid or solid-solid fuel and oxidizer combinations. Monopropellants and hypergolic fuels have also been used. All of these exhibit dangers, instabilities, and inflexibility. With liquid fuel and oxidizers there is the problem of "propellant slosh." If solid fuels and oxidizers are used such problems as uneven burning, excessively high combustion pressures, or complex grain (solid-fuel) geometry may arise. With solid fuel and oxidizer systems restarting is either extremely difficult or impossible, and throttling is almost inconceivable. The proposed system, however, includes both of these features. In this study a hybrid-fuel combination (solid-gas) system has been developed to overcome these problems. When burning a solid fuel with a gaseous oxidizer a system cannot be expected to produce as much thrust as one that utilizes a liquid oxidizer, but where efficiency is lost safety and simplicity are gained.

#First Award - Eastman Kodak Company
Honorable Mention - Society of Photographic Scientists and Engineers

#BALANCE CONTROL THROUGH NEURAL PROSTHESIS

Cetuk, Tony J., Cherry Creek H.S., Englewood, CO 80112;
8434 E. Fox Hill Pl., Englewood, CO 80112

Through electrical stimulation of the muscles in the human body, twitch and tetanic contractions can be induced for movement of the joints. Muscle contractions in the thigh region and movement of the ankle maintain balance together. These can be controlled through stimuli applied to electrodes placed above the muscles from an external device. The strength and direction of current depends entirely on the angle of posture. This type of indicator can be developed with design similar to the utricle of the inner ear. Skin resistance varies from person to person; therefore, accounts must be taken for synchronizing a balance device's current when placed on a different individual. By being designed mainly for paraplegics, this device will also rejuvenate their withered muscles.

#Fourth Award - General Motors ISEF

EFFECTS OF VELOCITY ON CORROSION

Perrigo, Van, Robert Service High School, Anchorage, AK 99507
1921 Congress Circle B, Anchorage, AK 99507

No abstract received.

ARGUS

Rapp, David A., Wheeling Park H.S., Wheeling, WV 26003
763 National Rd., Wheeling, WV 26003

Breaking technological barriers, Argus is an exceptionally versatile optical analyzer. This project is designed so that any corporation can increase and ensure efficiency in quality control and inventory control by the implementation of this low-cost inspection system on their production lines. This represents a significant advance because the system can eliminate the production and employment of defective components. This will conserve millions of dollars expended on recalls and discarded inventory.

Argus has been designed to electromagnetically analyze an object and provide immediate information about its type and quality. Then this data is compared with previous data to enable the system to watch for trending. Therefore, Argus will predict when machinery will begin producing defective components because of tool wear. If the parameters should exceed their limits, Argus immediately will commence shut-down procedure of machinery to prohibit the production of unusable parts.

Argus is an optical instrument consisting of an inexpensive dynamic memory which is light sensitive because of the photo electric effect. It is possible to interface Argus with the corporation's mainframe computer system and provide instantaneous inventory information as well as quality control checks.

This project will supply the need for a low-cost inspection system. Also, the system can be modified easily for use in many other applications e.g., a night vision system for surveillance and security, fingerprint and signature verification, robot vision, and missile guidance system.

#First Award - General Motors Corporation
Second Award - General Motors ISEF
Second Award - Institute of Electrical and Electronics Engineers, Inc.
Alternate to Scholarship - Ohio State University

#DEVELOPMENT OF A COMPUTER CONTROLLED ROBOTIC QUADRUPED VEHICLE PHASE II

Jones, Sande R., Jr., Blair High School, Hattiesburg, Mississippi 39401
903 Sioux Lane, Hattiesburg, MS 39401

My project entitled "The Development of a Computer Controlled Robotic Quadruped Vehicle Phase II" has been a two-year project to develop a low-cost all-terrain vehicle, which uses walking as its mode of locomotion.

Many forms of transportation and the methods through which they locomote have been taken from animals and insects. Although these man-made forms of locomotion sometimes differ greatly from the natural forms from which they were derived, they still retain many of the natural principles that have made them so successful for the animals that use them.

My project, affectionately nicknamed K-9, consists of four independently controlled legs, each made of an acrylic type material and balsa wood. The four legs are attached to the main body frame which has been fashioned from aluminum. The body frame houses the actuator circuits which control the vehicle's motions.

K-9 is controlled by a TRS-80 micro-computer which controls all aspects of the vehicle's locomotion. This total control is accomplished through a two-channel memory mapping system, each channel having 255 independent control commands.

The perfection of such a walking vehicle would have many beneficial ramifications for industry, the military, and the private sectors because it would supply these sectors with a very flexible and powerful form of all-terrain transportation.

#Alternate to Scholarship - Ohio State University

#MAG, THE SELF PROGRAMMING COMPUTER CONTROLLED ROBOT

Bryson James Ware
Rampart High School, Colorado Springs, CO 80918;
1730 Alamosa Drive
Colorado Springs, CO 80908

There are several reasons as to why I chose to build Mag. One of which is my interest in electronics and space technology. The use of the manipulator on board the shuttle is a good example of the applications of robotics technology in space. Mag serves as a prototype for the future explorers of such hostile worlds as Mars and Venus.

The ability to learn from one's mistakes is essential for survival and Mag can do just that. For any given situation Mag will rely on past experience for a possible solution.

In building Mag I used several large machines that were available to me in the school machine shop. Among them were a machine lathe, drill press, band saw, and milling machine plus numerous small tools. I put a complete parts list on my T.I. home computer for viewing at my exhibit.

In conclusion, I have learned how to design, build and program a computer in a period of 6 months without the benefit of a formal electronics course.

REFERENCES

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"How to Design and Build Your Own Custom Robot"
The TTL Data Book T.I.
Intel Component Data Book
"How to Build Your Own Self-Programming Robot"
"Semiconductor Reference Guide"
"Handbook of Advanced Robotics"
"Data I/O Reference Manual"
"Microcomputer Design"
"The Complete Handbook of Robotics"
"Android Design"
"Robotics Age"

#First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent Office Society
Honorable Mention - American Intellectual Property Law Association

TAKE SUN, SALT, ADD SOME WATER: THE RESULT IS ENERGY

Maldonado, Martin E., Colegio San Jose, Box AA, Rio Piedras, P.R. 00928
Arroyo St. #A-3, El Remanso, Rio Piedras, Puerto Rico 00926

The purpose of this project is to develop a simple technique to extract energy from small bodies of salt water. Solar salt ponds are not to be confused with Solar ponds, which simply collect and store the sun's energy for space heating. Salt ponds can be stratified, and the brine a few feet below the surface reaches temperatures near boiling, more than high enough to drive special turbines.

In a solar salt pond a layer of brine lies beneath a shallow layer of fresh, lighter water. The sun rays penetrate the top layer and heats the brine underneath. Even when heated, it is still too heavy to rise to the top, where the heat would be lost by convection, evaporation and reradiation. The brine gets hotter and hotter, sometimes more than 185°F, while the top layer acts as an insulating blanket. Such ponds rarely exist in nature, but in manmade solar salt ponds, stratification can be maintained and intensified.

How it works: hot brine is piped to the evaporator of a heat engine, where the brine's energy converts a fluid of very low boiling point from liquid to vapor. The vapor then goes through the nozzles of a turbine, turning the turbine wheel and the generator that produces electricity. Finally, the vapor is led to a condenser, where cooler water from the top of the tank cools it back to a liquid state, and the cycle begins all over again.

#STRENGTHENING BEAMS WITH FILLERS

Brian L. Davidson
Rapid City Central High School
Rapid City SD 57701
240 East Saint Charles
Rapid City SD 57701

This research was conducted to determine which aggregate (filler) produced the strongest and most efficient structures for horizontal beam and vertical pillar compression tests. Plaster was used as the binding material for the tests.

Twenty different aggregates were used: no aggregate (control), set in the freezer and the oven, glue, salt, flour, sand, gravel, thread, copper turnings, steel wool, crushed glass, metal strips, metal supports, and pipe cleaners. These were mixed with plaster into two different sets of molds. A right rectangular beam for spanning tests and a right truncated cone for compressional tests. Eighty molds for each set of tests were made (four samples from each aggregate).

The spanning test was a simple set-up. A C-clamp hanging at the center of the beam over a 10 cm span supported a bucket for weight. Weights were added until the beam broke. The compression tests were done on a commercial compression testing apparatus. The maximum load held before complete failure was the strengt .

The efficiencies, with respect to mass, area, and density, were calculated for both tests. The average for each aggregate was taken and then compared.

In span tests, steel wool was the strongest and most efficient. This was because of the excellent inherent tensile strength and binding quality steel wool has.

In compression tests sand was the strongest and most efficient. It bound the plaster together as most of the others broke under pressure.

Salt as an aggregate produced beams that had the least overall strength.

#Honorable Mention - Bureau of Reclamation/U.S. Department of the Interior

#AIR CIRCULATION AFFECTS INSULATION

Bullock, Chris A., Caddo Parish Magnet H. S., Shreveport, La. 71101
3321 Pines Rd., Shreveport, La. 71119

The method of applying loose-fill insulation in household attics is a major error costing an estimated fifty-two billion dollars annually. Data collected over the last five years demonstrates that the application of a membrane over the insulation would significantly improve the insulating properties of loose-fill insulation. This would reduce heating and cooling costs a staggering 50%.

This research project is the result of an attempt to compare different insulations using "K" and "R" values. It was found that the thermal conductivity constants used and accepted world wide are grossly in error. In fact, 10 inches of loose-fill insulation in an attic was found to have an "R" of 1, not 27.

Extensive tests were also conducted to determine if moisture condensation was affected. It was determined that moisture was reduced in all tests with a protective membrane over the insulation.

A 2 mil polyethelene film was placed over the insulation in two home attics. The utility usage was evaluated using climatological data and degree day comparisons. In all tests where conclusions could be made, there was a savings of 50% or more.

RECOMMENDATION: More extensive testing be done in various climates using uninhabited home simulators.

#Second Award - United States Air Force
Alternate Award - U.S. Department of Energy

#THE DEVELOPMENTAL DESIGN OF A COMPUTER INTERFACED SEISMOGRAPH

Sargent, Eugene, Fayetteville H.S., Fayetteville, AR 72701
1775 Janice Ave., Fayetteville, AR 72701

The seismograph is an instrument that has seen little change since its invention. With this project, I wanted to increase the efficiency of the seismograph by interfacing it to a computer.

I used a small model pendulum to aid in the design of my vibration sensing pendulum. The design I developed used a two knife-edged pivot system to reduce friction and increase reliability. The pendulum assembly was built out of aluminum stock held together with pop rivets. A magnet and an aluminum box filled with lead shot were fixed to the end of the pendulum. The sensing coil was wound on a small winding machine which I designed and built. I mounted the coil on a small cradle so that it rested between the poles of the magnet. A simple amplifier was built and housed in an aluminum chassis box. The first tests, using a strip chart recorder, produced even sine wave patterns which proved to be made by the undamped swinging of the pendulum. This problem was solved through a series of experiments with different damping devices. I built an analog-to-digital converter and coupled it to the user port of a Commodore 64 computer. I used assembly language for my programs because it is fast and it can process binary numbers efficiently. I developed a program that graphically simulates a strip chart recorder and stores the data on magnetic disks.

With this project, I was able to demonstrate the potential power the microcomputer could have for the scientist. I also made an improvement on the seismograph that greatly increases its versitility and efficiency.

#First Award - Acoustical Society of America
First Award - Society of Exploration Geophysicists
First Award - United States Air Force
Honorable Mention - American Intellectual Property Law Association

FRED (FRIENDLY ROBOTIC EDUCATIONAL DEVICE)

Herrmann, Steve L., Mahtomedi High School, Mahtomedi, MN 55115
648 Florence Avenue, Mahtomedi, MN 55115

This project depicts the design and construction of an ambulatory robot called FRED (Friendly Robotic Educational Device). FRED was designed in an effort to gain an understanding of electronics and robotics which includes an understanding of types of transistors, resistors, basic mechanical and electrical engineering, use of solder and the proper use of test equipment. He was designed also to show not only that a robot could be built with standard components, but that it was also a feasible goal. The procedure followed was to first design the basic motor and drive mechanism. This was followed by the circuit design for electrically driving the motors. A body to house FRED was obtained next, along with the design of a means of controlling him. He is both remote and computer controlled. The goal was obtainable, however, the amount of time involved was underestimated. Great care must be taken in mating mechanical movement devices with electronics. Static electricity proved to be a significant problem in the design of the shelf that is used to house the electronics. FRED serves as an example of what may be done with a basic knowledge of mechanics, electrical engineering and a little initiative. FRED has the capability of being expanded with a voice synthesizer and robotic arms which would enable him to perform simple tasks.

#BIONIC LIMBS: FACT OR FICTION?

Ivan Yaeger, Miami Central Sr. High, Miami, Florida 33147
1277 N.W. 88 St., Miami, Florida 33147

PURPOSE: To design and build a working, low-cost prototype prosthetic (bionic) arm.

MATERIALS: The arm's inner framework is composed of metal plates and girders with plastic inserts. The fingers are made of curved metal strips covered with cotton and gauze. Movements are actuated by three gearboxes and electric motors (3-6 volt), controlled by three double-pole, double-throw (DPDT) spring-to-center-off switches.

PROCEDURE: Through experimentation and trial-and-error development, I was able to design and build a working prototype of a bionic arm and duplicate the movements of elbow flexion, hand closure and wrist rotation to accomplish pronation and supination of the hand. This prosthesis is designed to be attached to the humeral stump in an above-the-elbow amputation.

OBSERVATION: By constructing the prototype, I discovered the difficulty in duplicating the movements of the human arm.

CONCLUSION: In my prototype, I was able to duplicate elbow, hand and wrist movements. With further refinement, (i.e., molded fiberglass shell and rubber glove to cover the exterior, stronger motors, metal gears, myo-electric controls to replace the switches and rechargeable batteries to replace the 6 & 4.5 volt AC adapters) this arm can be used by an amputee.

#Fourth Award - General Motors ISEF

TERRACED AIRFOILS II

Petro, Christopher L., Wm. A. Wirt H.S., Gary, IN 46403
4148 E. 13th Ave., Gary, IN 46403

I HYPOTHESIS

1983's "TERRACED AIRFOILS" demonstrated that terracing moderates stalls. This year, a trailing-edge flap will be added to last years's best configuration. Will this experiment verify 1983's project?

II TEST PROCEDURES

The control airfoil was performance documented, and then transformed with terracing. Measurements were by regulated DC power, load cell, and a digital voltmeter. All tests were limited to only lift normal to the chord, a top surface airflow, and flap deflections thru 45° down. A drag study was eliminated since the 1983 tests show no change. Many apparatus configurations were tried, producing approximately 3500 test points to get final acceptable comparisons.

III RESULTS

5° up flap setting is better without terraces. 0° thru 15° flap settings have up to a 10% loss in maximum lift with terraces, but this also is the optimum flap range for reducing stall effects. From 20° to 45°, maximum lift is nearly identical to the control, but the terrace's loss in lift after stall is less drastic.

IV CONCLUSION

After 15° flap, it seems that the boundary layer reverse airflow starts at the hinge line, leaving few terraces to impede it. Terracing generally has a better stall-lift curve than the control, and corroborates last year's results.

V APPLICATIONS

1. Reduces stall affects for general purpose airplanes.
2. Retractable terracing would reduce the landing speed of jets.

#BLIND AREA WARNING DEVICE FOR MOTOR VEHICLES

Hawthorne, Brent A., Fort Worth Country Day School
Fort Worth, Texas
Rt. 2 Box 141h, Granbury, Texas 76048

The purpose of this project is to develop a device for cars and trucks that can help to prevent accidents caused by the driver of one vehicle not being aware of another vehicle in his blind areas. For this purpose a sonic ranging device made by Polaroid was adapted to a car. The sonic ranging device's main component is the sonic transducer which sends out and receives the sonic impulse. Another part of the device measures the time elapse between the sending and receiving of a reflected sonic impulse. Since the speed of sound is fairly constant, the time elapse of impulse can be converted to a distance. This device attached to a car can indicate the presence of an object in its effective range. Attached to the fender of a car it will indicate the presence of and the distance to an object. This could prevent side swiping caused by moving into a lane already occupied by another vehicle as well as preventing accidents in narrow streets or parking lots caused by an inability to see how far away an object such as a car or building is. The use of this kind of device could greatly reduce injury and loss by helping to reduce these kinds of accidents.

#Honorable Mention - American Optometric Association and Auxiliary to the American Optometric Association

DESIGN AND DEVELOPMENT OF THE RING WING AIRCRAFT

Risa, M. Shane, Robert E. Lee H.S., Montgomery, Alabama;
537 Bowling Green Dr., Montgomery, Alabama 36109

This project involves the design of a new type of aircraft wing. The wing is in the shape of a ring and is known as a circular airfoil. The project's objective was to prove that this type of a wing can support an airframe in flight and is a possibility for the future.

The procedures involved were really very simple. First, I built a gliding model. This was constructed from cardboard and styrofoam. The tests were made up of glide tests and observations. Every time the model flew, the characteristics of the flight were different. These differences were noted and then corrected.

The first test involved only one flight. It was obvious that there was not enough lift. It was then that I decided to use a chine (pronounced like shine). A chine is a small wing that provides a small amount of lift. The next test proved that the chine worked. However, the model was tail-heavy, so I used half an ounce of lead in the nose. The third test showed that speed is a factor in its ability to fly. The model cannot fly at very low speeds. The problem could be corrected with larger wings.

The project successfully completed its objective. It proved that this wing can fly and is a feasible possibility for the future.

HOME BUILT INCUBATOR

Roberts, Bob Lee, Bevier C-4 High School, Bevier, MO 63532
504 Macon, Bevier, MO 63532

No abstract received.

#TRANSITIONAL LOCATION AND LAMINAR EXTENSION IN A HEATED BOUNDARY LAYER

Topolovac, Michael J., Torrey Pines H.S., Del Mar, CA 92014
M-14 North Lane, Del Mar, CA 92014

This project encompasses two problems in the field of hydrodynamics: 1. Can thermographic liquid crystals be used to detect various flow patterns on a submerged streamlined body? 2. Can a heated boundary layer be used to reduce drag on a submerged streamlined body? Reducing drag decreases the amount of energy required to propel an object through its medium. The key in reducing drag on a submerged streamlined body lies in manipulating the boundary layer, the microscopic layer of water surrounding a body. The theory behind the heated boundary layer method of drag reduction lies in extending laminar flow, which also reduces turbulent flow. Because laminar flow creates far less drag on a body than does turbulent flow, the drag should be reduced. A homemade water tunnel was designed and built. A body with the ability to heat up its boundary layer was constructed. Forces on the body were measured with a strain guage. A coating on the body with thermographic liquid crystal enabled the researcher to distinguish temperature differences on the body. Tests were run at temperature differentials of 20°c and 40°c. The 40° differencial body had a 26.6 percent average decrease in drag, while the 20°c differential body had a 22.4 percent average decrease. The percent decrease varied with the Reynolds number. The thermographic liquid crystals were very effective on distinguishing different types of flow in the boundary layer.

#First Award - General Motors Corporation
First Award - General Motors ISEF
Second Award - Marine Technology Society/U.S. Naval Institute

STEAM: EFFICIENCY, ECONOMY AND VERSATILITY FOR AGRICULTURE?

Stockwell, Todd D., Big Walnut H.S., Sunbury, OH 43074
12532 Vans Valley Road, Galena, OH 43021

Many farmers are experimenting with various methods to lower their production expenses, especially in the area of fuel costs. Realizing that the farm offers a vast quantity of virtually untapped energy sources, manufacturers are now offering units in which waste materials such as crop residue may be burned to provide heat for drying grain, heating buildings, etc. This project deals with the development of an extended use of this waste material utilization to provide energy for the tractors used in the farming operation. In order to develop the most economical system, it was decided that the use of some type of steam powered tractor would best adapt to the commercial waste burning units available. Through this project, two designs for a fireless (steam storage) tractor were developed, and the projected efficiency, economy, and cost versus savings of the units was calculated. Detailed fuel consumption studies for a corn residue system are illustrated. Efficiency testing of several "model" steam engines was carried out to develop more accurate projections. Analysis of the testing of a simple slide valve engine provided the basis for the development of a single acting, poppet valve, uniflow engine for the specific application. The project includes an analysis of the advantages of the fireless steam tractor over current diesel tractors, including the possibilities of the unit better meeting the trends towards smaller horsepower, higher efficiency tractors. Limiting factors and disadvantages of the proposed system are also discussed.

#Scholarship - Miami University
Alternate to Scholarship - Ohio State University

AUTOMATIC TELEPHONE DIALER

Fanelli, Paul, Rome Free Academy, Rome NY 13440;
504 Oakwood St., Rome NY 13440

The breakup of AT&T has provided increased competition for independent long distance telephone routing services. This increased competition has led to new services such as automatic redialers to ease phone usage. It was the purpose of my project to design and construct an electronic device which would store predesignated telephone numbers and dial the stored numbers in a fast efficient manner. I chose to work with TTL integrated circuits because of their availability, reasonable cost, and single five volt power requirement. My phone dialer can store up to one thousand digits in a format allowing for an individual phone number of any length. A simple two-digit number can call the dialer into action to dial the longer number in a fast touch-tone fashion.

I believe my concept to be valid and useful, but my circuit medium to be obsolete. I do not believe that the phone dialer which I have designed and fabricated is of direct marketable value because of the complexity and number of IC chips used. I plan to rebuild this project using a microprocessor with all controlling instructions in ROM. Such a unit would have more flexibility and could redial a number, dial a sequence of numbers, or dial a specific number under the control of a computer or other control hardware such as a burglar alarm system. Such a unit would have market potential because a quick change in software instructions could reconfigure the unit to meet the specific requirements of a customer.

#URBAN HYDROLOGY STUDY

Oyler, Elizabeth A., Mt. Lebanon High School,
Pittsburgh, PA 15228;
92 Youngwood Rd., Pittsburgh, PA 15228.

The purpose of this experiment was to determine the increase in peak discharge, one of the environmental consequences of commercial development of a natural area. I hypothesized that commercial development of a natural area would significantly increase the peak discharge of the area. To test this hypothesis, I first evaluated the physical parameters affecting peak discharge - area, average slope, ponding, and cover type - for a specific natural park. To obtain values for soil type, two sets of tests, in situ infiltration tests and permeability tests, were developed. From these tests, the soil was classified as type C. Rainfall and stream flow readings were taken for a period of ten weeks to evaluate rainfall for the park, as well as to find the actual peak discharge for the natural site. A model was then calibrated to represent the park developed with an athletic field and the peak discharge for the developed site was predicted. As expected, the peak discharge for a specific storm increased (83%). A model of the park fully developed with athletic field and condominiums was then calibrated, and the peak discharge was again predicted. The peak discharge for this developed site increased 380%. From this experiment, several conclusions can be drawn. First, the peak discharge of an area will significantly increase when the site is developed. Second, tests can be developed to accurately determine soil classification of a watershed.

#First Award - Bureau of Reclamation/U.S. Department of the Interior
Second Award - American Society of Civil Engineers

#RADICAL, PHASES III,IV (A REVOLUTIONARY AERODYNAMIC DESIGN IN CREATING AUTOMOTIVE LIFT)

Johnson, James L., Goose Creek High School, Goose Creek, SC 29445
104 Dennis Drive, Goose Creek, SC 29445

Automobile designers create their designs in such a manner that the automobile is always faced with overcoming two forces; a head on force, and a down force. The first force is unavoidable as cars will always need to displace air and in doing this will always lose a certain amount of energy. Auto manufacturers continuously work on this problem. My experiment takes a good look at the second force, the down force, which is produced by the car's weight and a characteristic desired by the manufacturer that uses air to increase the down force for more traction and cornering stability. This force is not entirely needed for long distance freeway driving when the greatest potential of fuel conservation exists.

It is my hypothesis that a car could use lift in order to reduce the down forces that increase friction and fuel consumption. Also, a retractable airdam could be designed that could control the lift at all times so that the car would have the stability it needs for crucial driving situations.

Forty-three different designs were tested extensively in a wind tunnel on three generations of balsa wood and clay models. The end product is a 1/24 scale clay model which, if full scale, would use lift to attain a 17% increase in fuel efficiency. It also had a low .24 C_D which resulted in an additional 14% increase of efficiency. (31% combined). The development of an ideal airdam provided the prototype with a stability device which would adequately return road friction in crucial driving situations.

#First Award - General Motors Corporation
First Award - Honda of America
First Award - U.S. Department of Energy
Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent Office Society
Fourth Award - General Motors ISEF

FUEL CELL RESEARCH ON THE EFFECTS OF ULTRAVIOLET LIGHT ON CATALYST PERFORMANCE

De Jesus, Pedro. Woodrow Wilson H.S., Washington, D.C. 20016; 5706 Nevada Avenue N.W., Washington, D.C. 20015

The activity of platinum catalyst for the conversion of organic fuels has been the subject of research by various scientists. In research on fuel cells, attempts have been made for several years to modify or replace the platinum in order to obtain a better or cheaper catalyst for the conversion of organic fuels. I decided to research on the effects of ultraviolet light on the catalystic performance of some of these substances. My hypothesis was that the activity of these catalysts would be affected when exposed to ultraviolet light.

Fuel cells were constructed by placing an ion exchange membrane between two platinum coated stainless steel mesh. Fuel was made by mixing methanol with potassium hydroxide and distilled water.

The rate of conversion of methanol in the presence of ultraviolet light varies. When the cathode is coated with platinum the rate of conversion of methanol is significantly accelerated. On the other hand, when the platinum coated cathode is mixed with p-benzoquinone the rate of conversion is greatly reduced. Similar results are also observed when platinum coated cathodes are mixed with other inorganic substances such as cupric sulfate and silver or other organic substances such as vegetable carbon black. The results suggest that the rate of conversion of methanol is increased when inorganic substances are exposed to ultraviolet light but decreased when organic substances are exposed to the same type of light.

#THE CONTINUOUS COUNTERCURRENT SOLVENT EXTRACTION OF ETHANOL BY N-OCTYL ALCOHOL: AN INNOVATION IN THE FIELD OF ALCOHOL FUELS

Jayatilleke, Hiranya, Bronx High School of Science, Bronx, N.Y., 10468
305 W.98th Street Apt.2RS, New York, N.Y., 10025

With the rapid depletion of our fossil fuel resources, ethanol has the potential for the partial and absolute replacement of gasoline as a motor fuel. Yet, one major problem has hindered the growth of this new source of fuel: an exorbitant amount of thermal energy is required in the distillation of the aqueous ferment to recover ethanol.

To solve this problem, another type of ethanol recovery method was proposed and evaluated, solvent extraction. This process utilizes the concept of adding a new component (solvent) to create two liquid phases in which the solvent is soluble toward ethanol and immiscible with water. Since the heat of vaporization of most organic solvents is considerably lower than than that of water, a significant reduction in the heat requirements of distillation is incurred. N-octyl alcohol, because it fulfils the solvent standards, is non-toxic to yeast cells, does not harm the internal combustion engine, and is reusable, was selected as an optimal extracting fluid for this process.

Three types of operations were used to assess the process feasibility of octanol extraction. A batch simulation explored the unknown equilibrium relations between the components; a continuous countercurrent extraction provided a multistage removal of ethanol from the feed; and a computer simulation was fitted to the empirical data to estimate the parameters of my process. The results derived from the experiments has shown conclusively that octanol extraction is a practical alternative to traditional approaches in the recovery of viable ethanol fuels.

#First Award - U.S. Department of Energy
Operation Cherry Blossom - United States Army
Honorable Mention - Gulf Oil Corporation

#WIND POWERED GENERATOR PHASE III; A COMPARATIVE ANALYSIS OF BLADE DESIGN, AIRFOIL, AND RPM

Knight, Arlin, Union High School, 6636 S. Mingo Rd, Tulsa Ok., 74133
5026 S. 91 E. Ave., Tulsa Ok. 74145

This is a continuation of a project started two years ago in which the optimum blade angle and physical design for a windmill were identified.

In Phase I a test base was constructed in such a manner that would allow the test blades to be turned to different angles for testing.

In Phase II I constructed five basic geometrical shaped blades for testing.

The problem I dealt with this year was to determine which blade shape when combined with what airfoil, and utilizing various blade angles will produce the highest torque.

The blades for this years project are of three different airfoils, each airfoil being used on one set of five different physical shapes. I used a flat airfoil, a thin airfoil, and a fat airfoil.

After the airfoils were designed, I then redesigned my test base. I added a "torque clutch" in order to measure the amount of pressure applied to the shaft.

The wind source for my testing was provided by a fan with a five foot diameter and windspeed of 9 mph at 8 feet. This fan was choosen because its diameter is greater than that of my largest blade.

My final conclusion is that it will take a combination of blade angles incorporated into a single blade, utilizing one airfoil to develop a blade which can be effectively used over a wide range of RPM.

#First Award - Gulf Oil Corporation

HOLOGRAPHIC INTERFEROMETRY: DETERMINATION OF PRESSURE-MEDIATED NANOMETRIC DEFORMATION AS APPLIED TO REINFORCED PLASTIC CONFIGURATIONS

Owens, Mark D., Marquette H.S., Michigan City, IN. 46360
Box 54, Michiana, New Buffalo, MI. 49117

The purpose of this research was to develop and modify a holographic interferometry system and environment capable of measuring nanometric flexural deformation in reinforced pultruded plastic configurations under weighted stress. Plastic configurations of various strands were selected as test specimens because of their myriad of applications in engineering, the military, and the automotive and space industries.

Double exposure holographic interferometry allowed two slightly different exposures of an object to be compared showing where flexural stress induced by various weights occurred on Kodak SO253 holographic film. Design, construction, and modifications were made involving components comprising the system: vibration isolated table, anti-vibration shutter system, optical system, and jig. External and internal vibrations and uncontrolled light were eliminated.

The holographic interferograms were analyzed by setting the interferogram in front of the same reference beam used during the recording. By inserting the number of fringes N into the formula M=N(W)/2, where W is the wavelength of the laser(632.8 nm), the amount of movement that occurs M can be found.

Through analysis of the various strands it has been concluded that the 14 strand(with 83% glass to 17% resin ratio) showed the least amount of flexural deformation while the 8 strand(with 60% glass to 40% resin ratio) showed the largest amount of flexural deformation under all loads. The application of the technique and the data has caused one plastics manufacturer to reevaluate and change their current concepts of what strand would withstand flexural pressure most effectively.

#Second Award - Optical Society of America
Second Award - Society of Photographic Scientists and Engineers
Third Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company
Honorable Mention - United States Army

BLUE COLLAR ROBOTS AND THEIR FUTURE

Stevenson, Craig J., Marion C. Moore H.S., Louisville, KY 40219;
8602 Michael Ray Dr., Louisville, KY 40219

Today's industrial robot makes up the largest robot population in existence today. There are some 3,500 robots hard at work in the U.S. This is a 35 percent jump from last year's figures. Experts are counting on further 35 percent increases in the next five years. At an increase such as this, there will be approximately 20,000 robots in the U.S. by the year 1990. With this type of growth and interest, I developed a pneumatic powered robot; demonstrating its advantages and applications. This has been a 2 year project requiring the design and construction of two robots, Prototype 1 and Prototype 2. Prototype 1, year 1, was developed to demonstrate the advantages pneumatics offers robotists. They are: (1) simplified design and construction; (2) lower weight and cost; (3) ease of repair; and, (4) tremendous, as well as, quick power. Prototype 2, year 2, demonstrates electric and pneumatic drive with the addition of mobility. Both robots, Prototype 1 and Prototype 2, are radio controlled allowing the operator to be remote from the device. In conclusion, the number of robots for blue collar applications will be increasing on a geometric scale with the development of advance feedback systems which will replicate the senses of man. The era of the R2D2 and 3CPO robots is fast approaching, thereby alleviating man from those laborious and hazardous tasks in his environment with pneumatic power serving as a major power source for robots.

#MANTIS - AN ARTICULATED SERVO-MECHANISM WITH MONOCULAR VISION CONTROLLED BY COMPUTER

Bratcher, Richard A., Duncan H.S., Duncan, OK 73533
709 Elder, Duncan, OK 73533

The purpose of this project was to engineer and build a working robotic arm that was accurate, durable, and displayed intelligence.

This goal involved both mechanical and electrical engineering. Drawings and schematics were made for the architecture of this machine, with many rough drawings, dimension lines and tolerances. The shape and placement of the component parts was dictated by function of the parts, each with the others.

This goal required absolute control of the device in relation to positional values. Control was achieved with a computer, which was designed and built by myself, linked to a control board, which controls polarity and power to five direct current motors. One motor serves a dual purpose; to control wrist rotation and grip of the hand. The device employs 6 axis of movement which by definition makes it a robot.

The agility of a device such as this proved to be remarkable, though not as smooth and flexible as a human limb. It offers repeatability and reliable execution of its tasks.

It is clearly evident to me that machines of this kind, can and will be used in great quanity, in the near future, to increase overall efficiency of production and to provide easily controlled limbs for those who have none. In addition, remotely controlled arms of this kind could be used as extensions of the human arm where desired.

#First Award - AT&T Network Systems
First Award - Battelle Memorial Institute
First Award - Ball Electronic Systems Division
First Award - General Motors Corporation
First Award - General Motors ISEF
First Award - Junior Engineering Technical Society
First Award - National Aeronautics and Space Administration
Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent Office Society
Alternate - Weizmann Institute of Science

MICROPROCESSOR-BASED SOUND ANALYSIS

Warren, Michael S., Stevens H.S., Rapid City, SD 57702;
Suburban Route, Box 253, Rapid City, SD 57702.

This project develops a low-cost sound analyzer capable of displaying sound in both time and frequency domains. The hardware portion of the project consists of an 8-bit analog-to-digital converter, a four-section Chebyshev low-pass filter, and the necessary support equipment. The conversion time of the ADC is 20 microseconds, giving a maximum sample rate of 50 kHz. The sample rate and low-pass filter are both variable, resulting in a usable analysis bandwidth of 20 Hz to 16 kHz. The total cost of hardware is approximately $65.00. The hardware is interfaced to the user port of a Commodore 64 microcomputer, which can then display or analyze the sound. The software, written in 6502 assembly language, consists of over 4K of routines which can display the sound in time domain or convert it to a frequency-amplitude spectrum. The conversion is realized through a radix 2 fast fourier transform using time decomposition and input bit reversal. The record size of the FFT can be varied so that either narrowband or wideband analyses can be performed. The speed of the transform can be as high as 100 milliseconds per frame. The available memory allows from one to eight seconds of sound to be analyzed. This results in a very flexible system where either time or frequency events can be emphasized. Possible uses include voice and word recognition, acoustic analysis, and musical applications.

#EPROM PROGRAMMER

Ouellette, Edward J., Carman High School, Flint, MI 48504;
5121 Briarcrest Drive, Flint, MI 48504

The problem I addressed was the need to design and construct a more efficient system for programming EPROM's. Specifically, my goal was to construct an adaptable, fast, low-cost system which would have many advantages over disk drives. Generally, the steps I took were: Researched EPROM's, machine language programming, computer interfacing and computer hardware; Designed a circuit for use on a VIC-20 computer; Prototyped the circuit; Tested and applied the system. The problem I addressed was solved and the goals were met by the system I constructed.

First, I chose the VIC-20 as the host computer for my circuit because it is extremely popular, easily adapted, and fits my budget (under $90). Secondly, I decided to extensively use the Expansion Port of the VIC-20 which has a greater number of information lines than the User Port, thereby increasing the speed of data transmission. My project also satisfies my goal of efficiency by using a common 28-pin DIP socket which is switch selectable for the various EPROM's. This design eliminates the need of special "personality modules" used on many other PEROM programmers, often costing up to $15 each. Finally, my project offers hardware adaptability using a DIP switch array to set the proper signals for the right EPROM, thus ending the need to always modify software routines.

My project has many uses: Game cartridge chip programmer, modifying character sets, Kernal ROM, adding new languages, and for non-volatile files.

#Third Award - Ball Electronic Systems Division
Third Award - General Motors ISEF

ASSISTED VS STATIC, AN ANALYSIS OF SATELLITE LAUNCHING SYSTEMS

Lund, Jeffrie R., Weber High School, Pleasant View, Utah 84404
530 East 3050 North, North Ogden, Ut. 84404

For the past 26 years the world has been using a static system of satellite launching. Is this, however, the most efficient way of satellite launching? The purpose of this project was to design an alternate system for satellite launching, and to compare this system with the static system of satellite launching, and to determine which is the most efficient.

In this project, two types of satellite launching systems are compared. First, the static system, and second, the assisted system. The static system is the system in use today, in which a rocket is launched from a rest position on a pad. The assisted system is a system in which the rocket is accelerated horizonally, and then is launched.

Two experiments were conducted in this project. The first was an experiment to test the basic principle of the assisted system. The second experiment was a mathematical test. This test involved a hypothetical rocket, that was launched using both the static and the assisted system. Both the total force expended, and orbital altitude were found for each. From the results of this test, the most efficient system was chosen. The system which achieved the greatest orbit with the least amount of force would be the most efficient.

The results of the first test showed that the assisted system would work, and the basic principle was proven. The results of the second test showed that the assisted vehicle was more efficient. It achieved an elliptic orbit of 729.45km, compared to the statics orbit of 561.41km. To achieve the same orbit as the assisted system, the static system would require an additional 35,679.5N.

#A HIGH SECURITY COMPUTER CONTROLLED ROBOTIC SENTRY SYSTEM

Smith, David C., West High School
Davenport, IA 52804
701 W. 17 Street, Davenport, IA 52803

The primary goal of this project is to design and construct a security system that will bridge the now present gap between the good security systems of today and the unbeatable systems that modern industry and contemporary residence will be demanding in the near future.

By researching present security installations, I have been able to devise a device that has all of the capabilities of state-of-the art systems along with additions that make this system clearly superior. The central intelligence device of this system is a computer. This computer is dedicated to the operation of the building into which it has been installed. The central computer monitors all doors and windows in the building. When it detects an intrusion, the computer will alert the proper authorities and then alert the armed robotic sentry. The robotic sentry will then proceed to the point of break and confront the intruder. The sentry will warn the intruder and, should it become necessary, use it's ultra-sonic weapon against the intruder. The sentry would then maintain a watch over the intruder until the authorities arrive. For application in a residence, a smaller, less independent monitoring system would be in order. This system is capable of performing many functions other than security; for instance, the operation of all the climate control functions and fire safety mechanisms would be well within the capability of this total building management device.

#Third Award - General Motors ISEF
Third Award - IEEE Computer Society

VM/CMS ON A MICROCOMPUTER

Hauser, Jeff M., Von Steuben H.S., Chicago, IL 60625;
6214 N. Avers Ave., Chicago, Il 60659

Many people who have pursued careers in mainframe computers are now buying microcomputers for personal use. These individuals must now learn a new system in order to write programs or do word processing on their new machines. To ease the transition, I have developed a series of programs that will enable the micro to respond to mainframe methods.

The procedure used was:

1. Define clearly the differences between micros and mainframes.
2. Decide how an instruction that works on a mainframe could be meaningful to a micro.
3. Decide what language to use for writing the programs.
4. Write a series of programs that intercept the mainframe type instructions and convert them into equivalent micro instructions.
5. Have people try the programs and then note when problems arise.
6. Solve the problems that are reported to me.

It is possible to write a mainframe system for a microcomputer enabling a person who has used only mainframes to adjust to a micro with a minimal amount of preparation. The user first has to learn how to power-up the machine and how to place disks in it. Later, he has to learn how to initialize disks for the system.

#A COMPUTERIZED METHOD OF AERODYNAMIC MEASUREMENT AND ANALYSIS

Sandberg, Jabe A., Cedar High School, Cedar City UT 84720
231 Monterey Drive, Cedar City, Utah 84720

Previous methodology for measuring forces induced in a wind tunnel involves mechanical measuring devices incompatible with computer technology. Sensing mechanical pressures electronically would enable computer capabilities to be utilized in wind tunnel testing. No methods for this electronic sensing existed, and the design problems therefore became making a sensor capable of registering applied pressure as a corresponding electrical characteristic, and designing a system to implement these new capabilities.

Carbon impregnated foam was sandwiched between two conductive metal plates, and a sensor block was constructed. Employing four sandwich assemblies, the sensor block could measure pressure in any direction. Changing the four varying resistances in the sensor block into digital electronic numbers compatible with computer equipment required design and construction of an analog/digital conversion board giving 8 bits resolution output with a built-in 8 input multiplexer.

Software consisted of routines selecting one of the four implemented channels to be read as a digital number through the computer's user port. Basic digital signal processing software was also written to provide interpretational, pictorial and numerical readout. Magnetic disk storage was provided for future data analysis.

The system was used on airfoils to test aerodynamic characteristics of lift, gravity and lateral forces under varying yaw and pitch. The system successfully demonstrated the feasibility of the new electronic sensing method and its new computer applications including instantaneous visual display, formula translation and data storage.

#Second Award - American Astronautical Society
Second Award - General Motors ISEF
Alternate to London International Youth Science Fortnight - United States Navy/Naval Air Systems Command

#A COMPUTERIZED COMPARISON OF SOLAR MOUNTING TECHNIQUES

Drako, Dean M., Detroit Country Day, Birmingham, MI 48010
14240 Melva Drive, Warren, MI 48093

One of the major problems with the use of solar power is the high cost versus efficiency factor. Solar cells are both very expensive and very inefficient. The main goal of the research was to discover how much an improvement would be obtained, over the entire day, by employing either an energy seeking or a sun tracking system. The system was computer controlled and constantly monitered the output of two similar solar cells. In addition, it continually attempted to either seek for the highest available energy in the sky with one of the cells or to track the sun with one of the cells.
After taking eleven months of data it was found that the efficiency improvement for both the tracking and seeking systems was large on sunny days. The seeking system also showed a high improvement on partly cloudy days. The improvement was minimal on overcast days for both systems. The tracking system showed a small decrease on overcast days. The data indicated that a seeking system might be a cost effective investment in a mostly sunny or partly cloudy environment. The tracking system would be most appropriate to a sunny climate. Neither system would be cost effective in a generally overcast area.

#Third Award - General Motors ISEF

COMPUTER GRAPHICS TABLET

Boran, Canice P., Comstock H.S., Comstock, MI 49041;
1504 Trimble Avenue, Kalamazoo, MI 49001.

The purpose of this experiment was to create a means to input graphics into a computer from an external source. This was accomplished by the utilization of the game ports to interpret changes in resistance for conversion to acceptable values. This allows the program to compute horizontal and vertical components. The changes in resistance are supplied by potentiometers (or pots) which change resistance by rotation of their wiper arms. One pot supplies the angle of a radial arm and another provides the length of the radial arm. Using trigonometry, instantaneous x and y positions are calculated and plotted. Data was obtained from the apparatus and points were calculated and plotted successfully. This experiment shows it is possible to plot points representing calculated values of the data supplied. The design and construction of a working model proved challenging. Many approaches were tried before a successful method was found. Due to the sensitivity of the apparatus and the fact that a human hand cannot operate as a completely rigid body, the images that appear are slightly imperfect. Storing and retrieving of images is possible and enables the user to apply the program in various design oriented fields.

FURTHER EXPERIMENTATION ON AIRFOILS
IN AN EXPERIMENTAL WIND TUNNEL

James Duer
Russellville High School
Hwy. 79, West
Russellville, KY 42276

Home Address: Auburn, Kentucky

Over the course of three years this project has developed and improved. Although originally designed for testing experimental airvoil, this project which I have designed, has become just as much of a test for the wind tunnels. This year a new wind tunnel, sight source and airfoil of my own design will be tested. In the past, stall angle was the only trait tested of the airfoil, but further developments include drag and lift as well. The ultimate in simplicity without forfeiting accuracy and quality has been used in the wind tunnel to make it practical for any person's use.

WATER ABSORPTION AND TORSIONAL STRENGTH ON LUCITE

Thomas, Carol L., Thomas Stone High School, Waldorf, Maryland 20601;
Route 1 Box 73, Bryantown, Maryland 20617.

The purpose of my investigation of polymethyl methacrylate, better known as lucite, was to determine whether the torsional endurance is affected by the influence of water absorption. Rod-like specimens with notches in the centers were constructed from lucite and placed in water for designated amounts of time. Upon withdrawal from the water the specimens were placed into a machine and subjected to torsional loading. It was determined that there was a decrease in the torsional strength of the material after a period of immersion in water.

#RADIATION, MAGNETIC, AND ELECTRICAL FIELD ANALYSIS OF PHOTOELASTIC RESIN SOLIDIFICATION.

DAVID A. LOWE - SUNNYSIDE HIGH SCHOOL - SUNNYSIDE, WA 98944
RT. 3 BOX 3172 SUNNYSIDE, WA 98944

OBJECTIVE: To mathmatically analyze the principle stresses that specific force variables (Thermal and Microwave Radiation, Electromagnetic, Electrical, and Magnetic Fields) create within given shapes (circle, square, diamond) using different photoelastic resins, and to observe the effects that these forces have upon aspects of each resin's solidification.

METHODS: I used 2 types of resins (caroplastic and PL-2) with metal and plastic molds. In thermal radiation tests, the condition degrees were -20, 20, 60, and 100°C; 10, 30, 50, and 70 minutes for exposure times. In microwave radiation tests, the degree was constant and exposure time was .5, 1, 1.5, and 2 minutes. In magnetic field tests, exposure time was constant and degree varied from 2, 6, to 10 cm distance from source. In electromagnetic tests, 1, 3, and 5 volts were used for 2, 4, and 6 minutes. In electrical field tests, 1.5, 3, and 4.5 increments of voltage were used for 5, 10, and 15 minutes. These objects were analyzed for their average stress concentration value (Kt) using Photoelastic Stress Analysis, solidification time, and iron filing motion distance.

CONCLUSION: Using computer analysis, both resins resulted in similar graphs. In an average of all shapes, Kt increased as condition degree and exposure time did in electromagnetic and magnetic field testing. PL-2 in electric field tests showed similar results. Kt decreased as degree and exposure time increased in the remaining electric field, thermal, and microwave radiation tests. Solidification time increased as degree and exposure time did in microwave radiation, electromagnetic and magnetic field tests and in exposure time tests with the electric field. It decreased as degree and exposure time increased in thermal radiation tests and decreased as degree increased in electric field testing.

#First Award - Worthington Industries, Inc.
Fourth Award - General Motors ISEF

FREQUENCY -VS- DIRECT IN TRANSFER OF DATA USING FIBER OPTICS

Dziuk, Patrick M., Underwood H.S., Underwood, ND 58576
710 Lincoln Ave., Underwood, ND 58576

The goal of this project was to find out the advantages and disadvantages in the following types of data transfer using fiber optics: (1) frequency, (2) direct. Tests were performed on both systems to find the superior one. The experimentation factors were the following: Cost, Distance of transfer, Speed of transfer, Complexity, and Power consumption.

In doing the distance tests, the following procedure was followed. The two circuits were connected to various lengths of optical fiber. This process was continued until the system could no longer trip the relay on the receiving end. The porcedure for finding the speed of transfer is this. First, the transmitters were connected to a computer which would control a power swithc. This would simulate computer data being transfered to another computer. The information was then sent to the receiver. This was connected to an event counter and a one minuter timer. The test data was compiled on how far the system would send the data and the number of operations per minute it would perform.

The results from the tests showed that the frequency system could transfer 200 operations a distance of 127 feet. The direct system on the other hand could only send 80 operations a distance of 57 feet.

In conclusion, I found the superior system to be frequency. It can get the job done faster and send the information a farther distance before a signal repeater is required. Direct does have its good points though, like simplicity and lower power consumption. I feel that the transfer of data using fiber optics will be used increasingly in the years to come, and frequency modulation will be leading it.

#BIOMECHANICS: FUTURE MAN

Tharaeparambil, Anthony D., Jamestown H.S., Jamestown, NY 14701;
25 Delevan Avenue., Jamestown, NY 14701.

I. Purpose:
- A. To demonstrate the factors involved in the construction of a bionic limb.
- B. To demonstrate an actual completed bionic arm(of my own design and construction).
- C. To explain the basic principles of biomechanics.

II. Procedure:
- A. Graph an actual human arm
- B. Graph the bionic counterpart arm(blueprints)
- C. Construct a cardboard prototype to test design
- D. Redesign(correct flaws)and construct new prototype(wood & metal)
- E. Final design and construction of "skeleton"
- F. Application of "skin" to "skeletal" frame
- G. Graphing of size, strength, and specifics of arm

(Note: Steps A-F will be shown with photo and blueprint displays, step G will be displayed with the completed arm.)

III. Results(data):
- A. Completed arm(displayed with project)
- B. Motor torque: 64.32 in-oz / approx. four lbs. pressure per finger
- C. Contraction time: (approx.)52 seconds / battery: 3V max. per finger
- D. Blueprints(displayed with project, examples enclosed)

IV. Conclusions/Applications:
- A. May be used as prosthetic limb / may simulate normal human appearance(such as skin, hair...) / may simulate life functions (such as "pseudo-pulse")
- B. Present day advancements pose possibilities for wider usage

#Third Award - American Intellectual Property Law Association
Third Award - General Motors ISEF

DESIGN, CONSTRUCTION, AND ANALYSIS OF EARTH-SHELTERED AND ABOVE-GROUND TEST STRUCTURES

Germann, Eric K., Lincolnview H.S., Van Wert, Ohio 45891;
R. R. #1, Box 35, Delphos, Ohio 45833

Could earth-sheltering be employed as a means of energy conservation in this area and if so, what would the average percentage of savings under various winter conditions be?

This project set out to test this problem using two identically built structures for direct comparison. One was placed one-foot underground employing the elevational design, while the second one was left exposed to the air.

Test parameters ranged from extremely cold (i.e. -20°F to 3°F) to moderately warm (i.e. 25°F to 58°F).

Under extremely cold conditions, savings averaged 61%. Under moderately cold conditions, the savings averaged 51%. Under moderately warm conditions, the savings averaged 18%.

Another test was the reaction of the installation under extremely high winds. The test was started 24 hours prior to the arrival of a winter storm. The air temperature and ground temperature were within 5°F. The storm arrived and sustained winds of 45+ mph. The earth-shelter averaged a 62% savings. The overall savings through the whole test averaged 37.5%.

This was put into perspective with the heating costs of an average 2600 sq. ft. house. With the 37.5% savings, the heating bill was reduced from $78.52 to $49.07. This resulted in an average savings of approximately $150 through a heating season.

With this information, earth-sheltering is both practical and feasible in this area.

Future plans call for testing of cooling load reductions and solar heating practicality.

DEVELOPMENT OF AUTOMATED COMPUTER DRIVEN CONTROLS TO PROVIDE ENHANCED LASER PERFORMANCE AND REDUCED OPERATING AND MAINTENANCE REQUIREMENTS

Zielke, David M., Merritt Island H.S., Merritt Island Fl. 32952;95 Alhambra Ave., Merritt Island, Fl 32952

Cavity mirror alignment and gas mixture adjustments are the most time consuming operations encountered with large, high powered industrial and research lasers. The time and effort expended on these adjustments, and repeated readjustments, required to maintain optimum laser performance, may justify the use of automated, computer driven controls.

The system developed in the project was able to fulfill these automated functions. The computer driven system was capable of maintaining optimum laser output for extended periods of time, with less than 5% drift from the original setpoint.

#First Award - BDM Corporation
First Award - General Motors ISEF
First Award - Institute of Electrical and Electronics Engineers, Inc.
Honorable Mention - National Aeronautics and Space Administration

EFFECTS OF CH3-S-CoM IN NEGATING THE INHIBITORY EFFECTS OF 4-CHLORO-3, 5 XYLENOL IN METHANOGENIC BACTERIA

Johnson, Michael, John Adams H.S., South Bend, IN 46615 63251 Mulberry Rd., South Bend, IN 46614

Industrial wastes, particularly halogenated aromatic compounds are a major disposal problem for many industries. Because of their high toxicity, they can't be readily decomposed by aerobic or anaerobic waste treatment processes. Consequently they are usually stored in drums for burial.

In solving this particular problem, Balch and Wolfe found that the addition of HS-CoM when added to the extracts taken from methanogenic bacteria substantially negated the effects of the halogenated analogues of CoM (such as would result from the metabolism of a halogenated organic compound) in destroying the CH3-S-CoM methylreductase system.

Based ypon this work, bacteria were pretreated with CH3-S-CoM (a benificial analogue of HS-CoM) and fed along with combiniations of 4-chloro-3, 5-xylenol and raffinate to 4 reactors after an initial incubation period of 5 weeks. This system was operated for another 5 weeks before decreasing the alcohol concentration in the phenol groups and then operating it for a final 5 weeks period of time.

Upon completion of this experiment, it was found that the solids used in breaking down the aromatic waste, those from the primary and secondary reactors at the South Bend waste Water Treatment Plant, responded the best out of three different seed cultures, in terms of stabilizing the addition of the coenzyme analogue.

DESIGNING AND BUILDING A MICROCOMPUTER

Shakespear, Daniel, Catholic Central H.S., Redford MI 48239
4141 Wendell Rd., W. Bloomfield, MI 48033

The purpose of this project was to design and build a hand-held computer from commonly available components. I chose a calculator case (TI SR-50A) to house the computer, and designed the new circuit to use its keyboard and display. The circuit uses a Z80A CPU and 2716-1 EPROM which drain relatively large amounts of current. To make battery power feasible, the CPU, EPROM, and CPU clock are powered through a latch-transistor arrangement which allows them to drain current about 6% of the time. A PC board layout was drawn and a two-sided board was etched. In order to fit the circuitry into the case, it was necessary to design a tight PC board and mount three of the fourteen IC's under other chips.

I wrote a monitor program for the computer's EPROM. The current version provides four RAM files-two data files and two machine-language object files. All are accessible from the keyboard interface. All letters and numbers, and many punctuation marks can be stored in the data files. A program can override any functions of the monitor. The monitor was programmed into the EPROM. After a modification to the resetting circuitry, and other trouble-shooting, the computer worked.

The result of this project is a practical hand-held computer. The final product features 4K RAM, 2K EPROM, and a Z80A CPU running at 3.58 MHz. Total current drain is less than 50 mA.

#Second Award - Bell Electronic Systems Division
Honorable Mention - National Aeronautics and Space Administration
Honorable Mention - United States Air Force

COAL-GASOLINE MIXTURES

Wolfe, Eric A., Abingdon H.S., Abingdon, VA 24210
2157 Fairway Drive, Abingdon, VA 24210

This project involved two major technical challenges: First, making the proper coal-gasoline mixture, and secondly, testing the fuel in a "Lawnmower" type 5 horsepower Briggs and Stratton internal combustion engine. An ultra-cleaned coal with less than one percent ash was obtained and ground to an average particle size less than 10 microns. Five different coal-gasoline mixtures were tested. A Dynamometer Engine Analyzer was used to measure the engine performance as a function of horsepower and revolutions per minute (RPM). The test results showed that up to a 20 percent coal-gasoline mixture could be successfully used without engine modifications. A 15 percent coal-gasoline mixture gave the optimum performance and even exceeded the horsepower gained over gasoline in the higher RPM levels. The engine was disassembled after testing and no detectable engine wear was observed. Several mixtures of coal-diesel fuel were successfully made into a stable suspension. Diesel engines would most probably perform better on a coal-diesel fuel mixture since diesel engines are more forgiving on the quality of fuel used. However, the testing conducted here with a gasoline-type engine is more stringent and performance should even be improved with diesel type engines.

#First Award - U.S. Department of Energy

ALTERNATIVE FUELS: COAL

Campbell, Craig M., Rockledge H.S., Rockledge, FL 32955;
649 Rockledge Drive, Rockledge, FL 32955.

Coal is one of the fuels that can be used as an alternative to petroleum. Coal does, however, have drawbacks as a fuel because of the pollution that it produces when it burns, including chemicals believed responsible for "acid rain." A new design for a furnace burns coal at a temperature four hundred degrees cooler than it usually burns. This reduces the formation of nitrous oxides, which occurs at the usual high temperature of coal combustion. The new furnace also feeds calcium carbonate into the furnace with the coal. This reduces the amount of sulfur dioxide and trioxide in the exhaust by forming the compound calcium sulfate with some of the sulfur oxides. The calcium sulfate is removed from the furnace in the form of a sludge. This project is divided up into two phases. The first phase is to build a working model of a coal furnace, using the latest design of coal combustion, partially described above. This design is called fluidized bed combustion. In this design, coal and calcium carbonate are fed onto a bed of sand that has been heated by propane. This bed of sand has air jets underneath it that give the sand a "boiling effect." This causes the coal to burn more evenly because it behaves like a liquid. This also allows it to burn cooler, producing less pollutants. The second phase of this project is to remove the pollutants from the exhaust stream of the furnace. This will be attempted by chemical and mechanical means. The goal of this phase is to remove the pollutants without creating harmful wastes from the processes involved.

COMPUTERISED GOLF DRIVING SYSTEM

Mackman, Richard L., Garforth Comprehensive School, Leeds
1 Station Fields, Garforth, Leeds LS15 1PL

Golfers practise using a conventional practice net but don't get any idea how or if they are improving. A system is needed which will allow a golfer to practise and also get information about each stroke - in effect a golf stroke analyser. The project was to design a model prototype of such a system which could prove this idea as being feasible.

Five possible different solutions were investigated and assessed. The best solution chosen was then taken step by step through the designing of framework, sensor board, circuits and finally the computer software.

A golfball is placed on a tee in front of a light sensor, connected to the computer and is then struck onto a sensor board. The sensor board consists of 16 pressure sensors which are interfaced to the computer by a logic circuit. A computer times the flight of the ball from tee to board and then reads the number of the pad which has been hit. This information is used to calculate the trajectory of the golfball taking air resistance into account. Other information such as initial velocity,maximum and average distance achieved are also calculated and displayed on the VDU.

One of the major problems encountered was the formation of the sensor pads which needed to be simple but well suited to this application. As no such devide was available this led to the designing of special pressure sensitive devices comprising of carbon impregnated foam sandwiched between 2 cooper plates.

#Second Award - General Motors ISEF
Second Award - Junior Engineering Technical Society
Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent Office Society
Third Award - Institute of Electrical and Electronics Engineers, Inc.

DIGITAL ADDER-SUBTRACTOR

Schuler, Robert W., South River H.S., Edgewater, MD 21037;
687 Santa Maria La., Davidsonville, MD 21035

A digital adder-subtractor was constructed from basic logic circuits to demonstrate how a digital circuit can be used to perform a complex task. The basic logic circuits used consist of AND gates, OR gates, inverters, JK and D type flip flops, Binary Coded Decimal (BCD) to binary and binary and BCD converters, a binary adder, and BCD to seven segment display drivers. 7400 series Transistor Transistor Logic (TTL) chips were used. The input was via a calculator keyboard, and the output consists of 4 seven segment Light Emiting Diodes (LED) digits and 1 sign LED. The circuitry is divided into three sections; 1)input 2)process, and 3)output. The input section consists of timed circuits which scan a "row by column" keyboard and store the digital signals produced when a key is pressed. These signals are converted from one-of-ten to BCD then to binary. The process section adds by use of the binary adder and stores the accumulated sum, which is converted into the BCD needed to drive the output. The output section determines whether the number to be displayed is the input, or the accumulated sum, then converts the number to seven segment display format to be displayed by the LED digits.

INVESTIGATION OF WATER EXTRACTION FROM AIR USING DEW POINT CONDENSATION

Michael Ingram, Paducah Tilghman High School, Paducah, KY 42001;
1151 Sherwood Road, Paducah, KY 42001.

In this research, an apparatus was designed to condense water at the dew point temperature of air by simulating underground conditions. These conditions were similar to those of a heat sink about four to six feet underground. The tested variables were: ambient air temperature, simulated ground temperature, air flow and velocity, and relative humidity. By comparing the results of the extremes of the variables, it is very evident that each significantly affects the amount of water extracted ($p<0.0001$). The quantity of water extracted varied directly as the relative humidity and inversely as ambient air temperature and air flow were changed.

ENERGY SAVING DEVICES

Ingram, Clint L., J.M. Alexander, Huntersville, N.C.28078
Route 3, Box 510,
Huntersville, N.C. 28078

The purpose of this project was to build two energy saving devices- an automatic door opener and automatic venetian blinds.

The automatic door opener was built by using three different systems. They were the mechanical, electrical, and pneumatic systems. Energy was saved by the use of this system since the rooms are separated and doors are kept closed. This makes the heating of a home more efficient. The electrical venetian blind system was tested to determine the amount of energy it saved. Data was obtained by testing the system with insulated windows in the summer and the winter.

#STORAGE OF SOLAR ENERGY: A RENEWED APPROACH

Patel, Atul M., Bowie H.S., Bowie, MD 20715
12709 Sutters Lane, Bowie, MD 20715

Had it not been for coal, oil, or natural gas, we might today have a 'Solar Energy Economy' just as efficient as the economy we have today. But the natural resources are finite and that is why it is so important to learn about this infinite energy source: Solar Energy. Solar Energy can be stored in various materials but hydrous salts and water are among the best of storage materials. But salt has its disadvantages when a salt goes from a solid to a liquid, heat of fusion is absorbed by the liquid. When the salt goes back through the phase i.e. liquid to solid; the same heat formerly absorbed is now released as the Heat of Crystallization and is usually released at the melting point. Unfortunately the salt doesn't always crystallize at its melting point. Cooling continues way below the melting point and heat is lost. The only heat recovered is the heat as the salt cools. This problem can be resolved by adding nucleating agents to trigger crystallization at the melting point. Salt also has its advantages over water. For the same amount of energy stored, salt occupies five times less space than water does. Based on these and other results of experiments conducted in the field of storage of solar energy in salts and heat storing capabilities of water, I started working on the design of the Solar collector that would be efficient, take all factors into account and would be economical. The Solar collector was then built and tried out. This design was modified again so as to facilitate installing and maintainance problems that would occur in a real life situation.

#Third Award - General Motors ISEF

COMPUTERIZED ROBOTIC ARM INTERFACE

Andrew Jones, Moriarty H. S., Moriarty NM 87035
P.O. Box 544, Edgewood NM 87015

The purpose of my research in the field of robotics, computers, and interfaces (electronics) was to learn about present and past technology. These fields have advanced so much in the last few years that it is hard to keep up with. This field is wide open, therefore giving me the opportunity to explore to its fullest advantage.

After sufficient library research was conducted, keyboard and timing circuits were built for a "thinking machine". These circuits were too simple to control the robot. Therefore it was decided to use a Commodore 64 computer as the "brains" to the robot.

Using the current technology, experimental robots and robotic arms were constructed from Expert Lego Building Blocks. Building a robot was not the hardest challenge but finding gears to slow down the r.p.m. for robotic motions became the largest task. Electric motors were used instead of stepper motors to test how the two differ.

The interface is needed for transferring eight bit data into signals that the motors can use for on/off and forward/reverse motions. The interface can also handle feedback because it is directly hooked up with the computer. LED's are used for status and display. Different circuits were breadboarded to produce the best, most reliable interface.

Working in the field of robotics, computers, and electronics, a great deal of current knowledge was learned. In continuing this research, more information will be obtained for building future models.

#First Award - IEEE Computer Society

LET THE SUN SHINE IN

Goff, David H., Wheeling Park High School, Wheeling, W.Va 26003
183 Elm Crest Drive, Wheeling, W.Va. 26003

The purpose of this project was to construct a solar passive system for the absorption and retention of heat during the winter and to retard the absorption of heat during the summer.

The procedure involved installing an insulating unit and concrete Trombe wall in the southern side of a model house, built with an extended roof overhang. A control model was constructed with a single-glazed window in its southern wall and no Trombe wall or extended overhang. The interior temperatures of the two models were compared.

An infrared heat lamp was used as the heat source. It followed simulated paths of the sun on the days of the winter and summer solstices at 28° N. latitude.

The results were recorded with the use of a recording thermometer. Its probe was inserted through the northern wall of each house. The temperature inside the models were registered on the thermograph during the simulated days.

The comparison of the temperature differences of the two houses concluded that the solar passive system was more effective during the winter phase of the experiment. Although the solar passive house absorbed the heat more slowly than the typical house, it reached and maintained a comfortable temperature for ten hours. The typical house never reached a comfortable temperature. In the summer phase of the experiment, the solar passive house remained cool throughout the simulated day. The typical house was judged to be too warm for most of the daylight hours.

#Electromagnetic Propulsion

Olson, David F., Eveleth High School, Eveleth, MN 55734
613 Pierce Street, Eveleth, MN 55734

The purpose of this project is to study the principles of electromagnetic propulsion and to investigate the potential use of electromagnetic launchers.

The first step in this project was to gather information to gain an understanding of magnetic phenomena dealing with electromagnetic propulsion. Then experiments were conducted demonstrating the principles of repulsion, levitation, and electromagnetic induction. These principles are applicable to various aspects of electromagnetic propulsion.

The next approach was to further extend and apply these principles to electromagnetic launchers. A prototype of a future electromagnetic launcher for the purpose of propelling payloads and satellites through space was built. The next step was to develop a method of calculating the average velocity, acceleration, and thrust. An event timer was built that interfaces with an Apple Computer. When a test run is performed, the computer calculates and outputs the desired information.

The experiments indicate that the force from a magnetic field can levitate a payload and propel it at high speeds. Recent advances in energy storage and magnetic technology make electromagnetic acceleration a viable alternative to chemical propulsion for certain tasks, and a means to perform other tasks not previously feasible. Many electromagnetic launching systems are presently in the experimental stage. The most sophisticated studied so far is the mass driver. New electromagnetic launchers could have far-reaching impacts, and become an economical tool for space exploration in the future. This is an exciting technology with great potential.

#First Award - American Astronautical Society
First Award - Honda of America
First Award - National Aeronautics and Space Administration
First Award - National Association of Rocketry

A NOISE AND LIFT-EFFICIENT HELICOPTER ROTOR DESIGN

Rogers, Craig K., Handley H.S., Winchester, VA 22601
1617 Whittier Ave., Winchester, VA 22601

A serious shortcoming of the modern helicopter is the conspicuous noise of the revolving blades. This project is a study of the effect of airfoil design, blade pitch, center of pressure, and rotational speed on helicopter noise levels and comparative lift-efficiency.

A unit was constructed to measure the lift of a fixed rotor unit, incorporating a hub used as the base for a variety of rotor assemblies. These included two, three, and four blade rotors, as well as the controls of pitch and center of pressure. Blades were constructed utilizing various airfoils, shapes, and dimensions, to reveal comparative noise and lift-efficiency from a design standpoint. Lift and sound readings were recorded using a spring scale to measure thrust, while two microphones wired into a trace oscilloscope indicated sound levels as variations in the amplitude of the electrical signal. Readings were recorded for each assembly through four center of pressure settings, seven pitch settings, and three rotor speeds. These were then averaged to obtain a single set of data. The lift reading for each setting was divided by its corresponding sound reading minus its initial sound reading. This provided a quanta of lift per unit of noise. $(L/(S-S_1))$

Such data was graphed and analyzed. Effective blades were those with a deep, parabolic lift curve and a low, shallow sound curve. Wide blades proved superior to all others when great lift and stability was needed, while blades with pointed and curved tips proved to be the most sound-efficient. Comparative analysis shows my proposed compromise of an outwardly tapered blade similar in lift-efficiency to conventional blades in use. The construction of this design poses no new engineering dilemnas, with a 12% decrease in noise. (measured in decibels)

#First Award - General Motors Corporation
First Award - National Aeronautics and Space Administration
London International Youth Science Fortnight - United States Navy/Naval Air Systems Command

THE CARTESIAN DIVER HYDROELECTRIC GENERATOR

Scott, Ronald B., Jr., Morristown High School, Morristown, NJ 07960
28 Valley View Drive, Morristown, NJ 07960

Cartesian divers have long been used as a physics demonstration of air pressure. The divers are pressure sensitive and precision balanced glass bubbles. When partially filled with water they assume an upright floating position. As a force is added to the water surface in which they float, they will sink. When the pressure on the water is returned to normal, the divers resume their upright floating position. The force used to trigger the divers is increased air pressure above the water surface.

A wave strikes a pivoting wall which, in turn, increases the density and pressure of the air above the water surface within an airtight system. This airtight system is made of solid walls. The denser air puts extra force on the water surface, and the divers sink. As the wave subsides, the pressure decreases, and the divers surface.

Energy can be produced if these divers are part of a platform that has turbines and generators. As the divers surface and submerge, the turbines on the platform are forced through the water and operate the generators.

#Third Award - Marine Technology Society/U.S. Naval Institute

#RELATIVE FLUID-FLOW EFFICIENCIES OF POSSIBLE JET-ENGINE EXHAUST NOZZLES

Delapena, Raynard D., Kapaa H.S., Kapaa, HI 96746; 6163 Kala Kea Pl., Kapaa, HI 96746.

The efficiencies of possible jet-engine exhaust nozzles were studied and compared. Conic, parabolic, arctangential, and exponential revolutionary solids were used. Input/Output (I/O) ratios were 1:2, 1:2.5, and 1:3.

Exhaust-nozzle models were tested using a water-flow device. Velocities at input and output points were measured using a Pygmy Current Meter and a special rating table. Depth was also measured. Then, a "perfect" output velocity was calculated for each of the different I/O ratios using the Fluid Equation of Continuity. Thus, efficiencies were based upon output velocities relative to perfect velocities.

Results show that shapes based on the exponential function were the most efficient followed by arctangential, conic, and parabolic. Also, shapes with a larger ratio proved to be more efficient. Thus, the highest efficiency was obtained from the exponential model, I/O Ratio of 1:2, having a relative efficiency of 72.5%. The lowest was from the parabolic model with, I/O Ratio of 1:3, with a relative efficiency of 43.2%.

It was thus concluded that further research should be conducted to determine the best I/O ratio to apply to jet-engines based on the exponential function or any of its related functions. Precise results would mean a great advancement of aircraft efficiency.

#First Award - U.S. Department of Energy

Robotic Leg, David A. Marks, Pinole Valley High School, 1025 E. Meadow Ave., Pinole, CA 94564

My problem was to enable a robot to travel over uneven terrain, such as: stairways, curbs, retaining walls, and many other common household obstructions. The personal robots of today use wheels or tracks to travel with. Which, when used, have extreme difficulty in performing these tasks.

To overcome this problem I have desinged a leg, that when used with five others, will enable the robot to tackle the objects mentioned above. The leg in the project is only a model of the actual leg. I am using it to test the design before I build the actual legs. The model uses stepper motors to power the movement, and the actual leg will use linear extension motors from a Cessna aircraft landing gear. The model leg is interfaced to my IBM PC through the parallel port using a stepper motor controller card.

I tested approx. five designs before I came up with my final draft. Each one could take more stress than the previous one. Once I had my final draft I wrote a program that simulates the movement of the leg. The program then told me the ideal dimensions to make the parts. From there I built the model and changed the program to control the leg. Now the leg moves while the computer simulates the movement on the screen.

#THE EFFECTS OF FLY ASH ON CONCRETE

Anderson, Paul, Underwood H.S., Underwood, ND 58576
Coleharbor, ND 58531

My project involved the substitution of a given quantity of Class C fly ash for cement in making concrete. Fly ash is a waste product from coal fired generating plants. This is my second year of experimentation. My goals in the second year of my project were to : 1. Retest last years strength results by using more standardized methods; 2. Find the abrasion resistance of various mix designs by using my own hydraulic abrasion resistance test; 3. Write a computer program to analyze the cost savings of fly ash; 4. Strengthen my general background in fly ash concrete. I accomplished goal #1 by pouring concrete at the 25%, 50%, 75%, and 100% ratios of fly ash in to 6" x 12" cylinders, curing them in 100% relative humidity for 15 days and testing them in a press designed for cylinder testing. Goal #2 was completed by placing the 20 day old and the one year old samples one inch from a 300 P.S.I. pressure washer for 24 hours. The rate of flow was 1.75 gallons per minute for a total of 2520 gallons per test sample and the total for all ten tests was 25200 gallons of water. My third goal involved computing the cost per cubic yard and making formulas to compute the cost of regular concrete compared to fly ash concrete and the savings of using fly ash in concrete. Fourth, I attended a fly ash seminar and visited with various engineers in the concrete industry. In conclusion, I learned through my compression and abrasion tests that 25% replacement with fly ash was a viable way to cut costs and still have good strength.

#First Award - Worthington Industries, Inc.

THE EFFECT OF BODY SHAPE AND SURFACE ON WIND RESISTANCE

Bruce King, Resource Learning Center, B'ham, AL 35209
2505 Laredo Circle, B'ham, Al 35226

The purpose of this project is to show the part that the shape and surface of a body plays on wind resistance.

A wind tunnel was designed for this purpose. It is an open circuit wind tunnel with dimenisons of 1'x 1'x 3', with a plexiglass side for veiwing, and a door in the back for placing the cars in it. The wind source comes from a power lawn blower directed into the tunnel via gutter pipes. Wind resistance is measured in grams by a small diet scale attached to the cars.

The cars tested were made from small blocks of wood, all the same size, sanded to various shapes. After the shapes were tested, improvements were made in the designs and on the surface (i.e. the wheels were set into the body, and the cars were varnished). A model of a Kremer-bodied Porsche 935, a known car of little wind resistance, was tested for the sake of comparision.

Since the formula for the drag coefficient is too complicated for usage without the proper equipment, a makeshift formula had to be formulated. It was arrived at by measuring the drag on the object (F_o), the drag on the frontal area of the object (F_a), then dividing F_o by F_a. $C_d = \frac{F_o}{F_a}$

The conclusion of this experiment was that the cars with a rounded front and rear with the wheels set into the body and a varnished surface had the lowest amount of wind resistance. In addition to this, the drag coefficient of the Porsche using this formula is very close to its actual drag coefficient.

#A BIRD OF THE SUN

Bailie, Brian D., Notre Dame H.S., Lawrenceville, NJ 08648
43 Vahlsing Way, Robbinsville, NJ 08691

No abstract received.

#First Award - International Aerospace Hall of Fame
Third Award - American Astronautical Society
Fourth Award - General Motors ISEF

#DESIGNING, BUILDING, AND TESTING A PROPULSION SYSTEM FOR A HOVERCRAFT

Turnipseed, John Parker, Weir Attendance Center, Weir, MS 39772
Rt 2 Bx 114, McCool, MS 39108.

A hovercraft is a vehicle which travels over any surface on a cushion of air trapped in a chamber under the craft. Before a hovercraft has any potential for being a serious candidate as a transportation vehicle, it must have some type of propulsion system.

In this project, an experimental hovercraft was constructed with innovations in design that included: a circular shape, lightness, a simple repairable skirt, and most importantly, a ducted lift fan. For this hovercraft, three types of propulsion systems were designed, built, and tested. These three systems included a tilt system in which the circular shape of the craft helped in balancing of the craft when tilting; the puff port system in which two hinged doors were positioned near the rear of the craft to bleed air from the plenum chamber thereby allowing the craft to go forward; and a ducted propeller in which a high speed propeller was positioned inside a shroud to allow effeciency when using high propeller speeds. The hypothesis was that the most effective way to propel the hovercraft would be the ducted propeller, followed by the puffports, and finally the tilt system.

A test course was set up to test this hypothosis. By timing the hovercraft at different intervals along the course, calculations were made of acceleration, velocity, and of the force exerted by each propulsion system.

The results showed that the ducted propeller provided 30 times more usable thrust than the puffports or the tilt system.

#First Award - General Motors Corporation
First Award - United States Navy/David W. Taylor Naval Ship R&D Center
Fourth Award - General Motors ISEF

THE USE OF TROPICAL FRUIT EXTRACTS AS A SOURCE OF ETHANOL AND ITS APPLICATION IN FUEL TREATMENT

Rivera, Magaly, Lola R. de Tio High School, San Germán, P.R. 00753;
Calle del Rio #100, San Germán, P. R. 00753.

The scarcity of fuel and the finding of alternate sources of energy is one of the problems affecting Puerto Rico today. Different attempts have been made to find a replacement or an alternative to petroleum without success.

This investigation attempts to find a use for some types of fruits which are quite abundant in Puerto Rico but usually are allowed to rot on the trees as well as some imported ones which if spoiled for human consumption are thrown away. The fruits were fermented to obtain alcohol. Results indicate that bananas and the fruit known locally as "jagua" produced the largest amount of CO_2 on fermentation, therefore, should be the highest producers of ethanol. However, upon destillation grape fruits and lemons gave the highest yields of alcohol.

Percent of alcohol produced was determined for each fruit extract assuming only alcohol and water are present in the distillate through spectrophotometric analysis. This was done to determine if it was necessary to carry out further distillation to improve the quality of the distillate.

A grass mower was run under gasoline for a period of time. The combustion chamber was dissambled and photographed. The distillate of the different fruits was mixed with high quality car engine gasline. Water from mixtures was separated by alcohol distribution in the gasline. Mower was run again with the mixtures to see the ratio of volume consumption to time An attempt was made to determine best the best gasoline-ethanol ratio that yields the best engine performance.

#RICE IS NICE FOR THE HOUSE OF HULLS

Coburn, Chelby Ann, Washington School, Greenville, Ms., 38701
619 Wildwood Rd., Greenville, Ms., 38701

The purpose of this research was to refabricate and test rice hull bricks in comparison to clay and sawdust bricks. Rice hull bricks are based on the principle of substituting rice hulls for 30% of the clay in common clay bricks. When baked in a kiln, the rice hulls burn out, leaving a small amount of ash in air pockets throughout the brick. This results in a lightweight, insulating brick. Since the rice hull brick is lighter weight than the clay brick, it is possible to transport 1,000 more bricks on a shipment than the clay bricks. This establishes an economical factor for the transporter as well as the buyer. It has a tensile strength of 1,300 lbs./sq. in. It was found that rice hull bricks are pliable, can be cut with an ordinary handsaw, can take and hold nails or screws as well as lumber , and are highly fireproof. In an overall view, the rice hull bricks are more economical and practical than clay or sawdust bricks. The properties of the rice hull brick, both in abrasive-wear characteristics and in crack-resistance, added to its exceptional insulation properties, would make it a worldwide success. Their best use would be for the building and lining of kilns and fireplaces. The use of rice hulls as an additive to bricks warrants further research, especially in areas where rice hulls are plentiful.

#First Award - Society of Women Engineers
First Award - Worthington Industries, Inc.
Fourth Award - General Motors ISEF

#A STUDY OF EXPERIMENTAL AND CONVENTIONAL SAIL DESIGNS

Karen Louis Bibb, Imperial H.S., Lighthouse Point, FL. 33064
567 S.Sonora Cir, Indialantic, FL. 32903

The purpose of the first phase of this research was to establish a definite relationship between a sail's shape and its power under various wind and sail trim conditions. This was accomplished by evaluating aluminum models of sail shapes in a wind tunnel.

Lift and drag for the 16 models were measured using the Florida Institute of Technology wind tunnel. Each model was tested three times at angles of attack from 0° to 35° and at wind speeds from 5 to 35 mph. A total of close to 2000 pairs of lift-drag data was collected. The resulting lift and drag coefficients for each angle of attack were calculated. In order to compare the aerodynamic force of each model, the component of force in the direction that a boat would sail, measured as an angle β to the apparent wind, was calculated using vector addition.

The results shown by the graphs of the resultant coefficients can be summarized in terms of the trends of general shape characteristics over range of β. The trends of this research support present sailmaking practices in the area of maximum camber depth, but indicate that the maximum camber should be placed farther forward.

These results have been used to construct a full-sized sail, which has been tested against a "standard" sail for the same boat. Series of boat speed measurements for each sail were taken at various wind speeds and points of sail. The mean speeds for each point of sail and wind speed were compared using t-tests. In all cases, the test sail was significantly better (at the .001 level) than the conventional control sail. From these results, it can be concluded that the results of the wind tunnel tests are accurate and applicable to modern sail design.

#First Award - National Aeronautics and Space Administration
First Award - United States Navy/Office of Naval Research
Third Award - General Motors ISEF
Honorable Mention - American Intellectual Property Law Association

WHICH METHODS CAN IMPROVE AUDITORIUM ACOUSTICS

Riat, David A., Wamego H.S., Wamego ,KS 66547
Rt. 1, Belvue, KS 66407

The Wamego H.S. auditorium has had a long reputation for poor acoustical qualities. Through years of performances in the building, the experimenter became acquainted with some of the acoustical problems. When certain controlled conditions inside an auditorium are changed, what effect will the changes have on the auditorium's acoustics?

To determine these effects, testing was done inside the auditorium using various frequencies and noise as a sound source. Tests measured reverberation times, the effects of blankets placed on a wall of the auditorium, the effects of a backdrop placed at the rear of the auditorium stage, and the surface of the glass in the balcony covered with blankets.

Reverberation times were found to be too long at lower frequencies and too short at higher frequencies. The blankets were found to only absorb the sound in certain sections of the auditorium. Tests which involved the balcony glass cover and the backdrop on stage significantly affected only a few sections. It was recommended that the glass structure in the balcony be be removed to help shorten reverberation times. Upholstery and carpeting were also recommended to help shorten reverberation times as well as provide added comfort to the audience. The side walls of the auditorium were also recommended to be replastered with an acoustical tile which would better reflect high frequencies.

#First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent Office Society
Honorable Mention - Acoustical Society of America

COMPUTER ACTIVATED TRANSLOCATOR (CAT-115) - ROBOT

Mattie, Mark E., Notre Dame H.S., West Haven, CT 06516
219 Maple Ave., North Haven, CT 06473

The purpose of project CAT was to construct a proficient mobile robot using junk and refined electronic components obtained from games, radios, stereos and, in rare instances, parts from Radio Shack. In addition the robot was to be compatible with various host computers ranging from the grossly oversimplified computer (such as the Sinclair ZX-81) to a complex main frame.

To promote such universality, CAT secures its data directly from the host computer's CRT via 4 small opto couplings. The opto couplings are simply photo transistors placed and held on the CRT by a suction system. These 4 channels being linked into the robot's own on-board computer, may control up to 100 functions.

Carrying data from the robot back to the computer is executed in a manner which again complies to the project's theme of universal compatibility. A typical joystick game's port is used as an interface to relate all robotic data. All data is transmitted to the computer in the form of resistance values. Hence, a variable such as angular displacement of the pincer arm is read as an impedance magnitude (resistance as a function of angular displacement).

#Third Award - General Motors ISEF

#DESIGN AND DEVELOPMENT OF A SOLID-STATE INDUSTRIAL CONTROLLER

Boesch, Mathew A., Bryan High School, Bryan, Ohio 43506
R. R. #2, Box #22, Bryan, Ohio 43506

This project dealt with improving the operation of an American Trumatic laundry flatwork folder. This machine is employed in an industrial laundry to receive flatwork (sheets, pillowcases, towels) from a flatwork ironing machine and to fold the flatwork lengthwise into quarters. It then delivers the folded flatwork to a table where it is cross folded manually.

The operation of this machine is hindered because it relies on mechanical controls. This system of cams, clutches, levers, and switches measures the flatwork and synchronizes operation of a folding mechanism at proper intervals. But, due to the machine's age, the mechanical controls have metal fatigue and do not function correctly.

My proposal is to replace all moving parts of the mechanical controls with a solid-state, digital electronics circuit. This circuit, an original design, incorporates readily available parts such as TTL integrated circuits.

Having designed and trial breadboarded this circuit, I wire-wrapped it permanently on a printed circuit board. The finished circuit, a solid-state industrial controller, fulfills its design parameters and operates correctly. I will install the finished controller in the flatwork folder during the summer of 1984.

I designed and constructed a model to illustrate the capabilities of the solid-state controller. This model measures, via the solid-state controller, a cardboard sheet of random length. The model then marks this cardboard sheet, which represents actual flatwork within the folder, where the machine will fold it.

#First Award - Honda of America
Scholarship - Franklin University
Scholarship - Ohio State University
Second Award - General Motors ISEF

#AIR CUSHION CONTAINMENT PHASE 3

Stults, Mark D., Rosenwald Jr. High, Panama City, Fl.,32401
7105 Diane Lane, Panma City, Fl., 32404

The purpose of this experiment was to design and build a small scale air cushion vehicle (ACV). It contained a blower, skirt system and seven different types of craft. I hypothesized that I would be able to keep a barge-like device above ground floating on a cushion of air. I made several different craft and tested them for the amount of reduced friction by measuring from the bottom of the craft to the ground.(skirt length) When I had exceeded skirt length it was considered a success. Success/failure on the first two craft was 20mm. Craft three through seven had a success/failure point of 15mm. The first and second craft were large and overweight, so I discontinued their use. By reducing the size of the craft I thought I could have less weight. The third craft and the fifth craft, both plenum designs, and the seventh craft, a peripheral design, were successful. The fourth craft with a bag skirt system and the sixth craft with a cone system didn't even get off the ground. The fifth craft with an open plenum design was the most successful for the given lift fan and motor. It had the most lift above the success/failure point. My hypothesis was right because I did make an Air Cushion Vehicle. I will be able to hover a successful propulsion system when the size of the craft is enlarged and the power of the lift system is increased.

#Fourth Award - General Motors ISEF

HOW DO NOTCHES AFFECT THE STRENGTH OF MATERIALS?

Hunckler, Paul T., Central Catholic H.S., Lafayette, IN 47905
2323 Ellen Dr., Lafayette, IN 47905

This project investigates how notches affect the strength of uniform materials. Ten bars of aluminum are used and five are thicker so a square notch could be cut down to the same thickness as the other five bars. Each bar is clamped with the notch up in a cantilever position. A hook is then attached to the end and the amount of deformation is measured as the load is increased.

The results are then plotted in a load vs. deformation graph to locate and compare the yield points and curves of the bars. Then the commercially available ANSYS finite element program, that is widely used by industry, is used to calculate and illustrate the x-axis stresses each bar experienced and to check the experimental results.

The results of each showed that the notched beam yielded much sooner and experienced higher stress. Therefore, the stress concentrations at the notch root caused the notched beam to yield sooner, even though it has as much material below the notch.

This shows why stress analysis is very important for products experiencing loads. Complicated structures such as airplane wings, bridges and building frames, as well as simple structures like bicycle frames, hammer handles, and saw blades can be engineered to be safe with the knowledge of how a notch or cut affects their strength.

ENVIRONMENTAL SCIENCES

#DETERMINATION OF LETHAL LEVEL OF CRUDE OIL ON BRINE SHRIMP

Hardee, Janette L., Robert E. Lee H.S., Tyler, TX 75701;
Rt. 1, Box 212B, Flint, TX 75762

Man's turning to the oceans as a source of energy production and transport has caused the problem of petroleum pollution. This pollution has a detrimental effect on marine life and therefore negatively affects human life. This study was conducted to determine the lethal level of crude oil on zooplankton; as they are the base of the oceanic food chain. Brine shrimp were used to represent the zooplankton. Varying concentrations of crude oil were added to salt water containing brine shrimp in order to determine the lethal level. In the experiments the death rates averaged 85% or more in concentrations greater than 1,380.49 ml. of crude oil per 1,000,000 ml. of salt water.

#Alternate Award - U.S. Department of Energy

AN ACCUMLATIVE STUDY OF ACID PRECIPITATION

Corria, Larry, Lincoln Senior High School, Sioux Falls, SD 57105
403 West 22nd, Sioux Falls, South Dakota 57103

This experiment was performed to detect the amount of sulfuric and nitric acid in snow and rain samples taken in the city of Sioux Falls, South Dakota. This project was based on snow samples since the weather conditions allowed the sampling of only three rainfalls which occurred in the month of February. I also attempted to test the levels of sulfur dioxide and nitrogen dioxide present in the air. Humidity and temperature may have influenced the accuracy of the testing. This experiment took into account the wind direction and possible sources of the acid present in both forms of precipitation. This experiment was not performed to determine the sources nor prevention of acid rain but to determine the general acid rain (and snow) conditions of Sioux Falls. I found the pH to average 5.0 for snow and 5.2 for rain samples. I found the sulfuric acid to average 1 ppm for snow and 2.5 ppm for rain and an average nitric acid level of .36 ppm for snow and .7 ppm for rain. The ratio of sulfuric acid to nitric acid based on both averages from snow and rain samples was 3.4 to 1. I feel that the snow and rain sample results show that the acid levels are of no immediate danger since the danger level of sulfuric acid is 100+ ppm and nitric acid is 10+ ppm.

#HYDRA REAGGREGATION: A RAPID ASSAY TO PREDICT TERATOGENTIC HAZARDS INDUCED BY ENVIRONMENTAL TOXICITY

Kudla, Arthur J., Fitzgerald High School, Warren, MI 48091
21487 Curie, Warren, MI 48091

Before drugs, chemicals, and food additives are safety certified, they need to be tested in lengthy and expensive experiments. Such evaluation, however, does not keep up with the rapid development and production of new compounds. The purpose of this study, therefore, was to design, develop, and validate a new rapid assay to simulate embrogenesis and to determine the teratogenic potential of chemicals. After testing many organisms, adult Hydra attenuata were used to evaluate the toxicity of several substances, including salicylic acid, lithium chloride, 2,4,5-trichlorophenoxyacetic acid, and Agent Orange. Each chemical's lowest toxic adult and "embryo" dosages were determined through a series of 28 tests, to within one-tenth of a log concentration. Unique methods of tissue culturing of "embryo" hydra were developed to dissociate Hydra attenuata into their component cells and to form pellets which were to be ejected into reaggregation media containing specific concentrations of the test substances. While studying, at six time intervals, the growth reactions of adult and "embro" hydra exposed to the chemicals, numerous controls were maintained.

Through an analysis of the results, validation by comparison with published rodent studies, and statistical verification, it may be noted that the Hydra attenuata assay is a viable screening technique predicting the magnitude of a chemical's toxicity to developing organisms. Since many compounds cannot be adequately tested by traditional methods before being distributed within the environment, this new assay will identify those which mandate further testing before dissemination.

#First Award - American Medical Association
First Award - General Motors ISEF
First Award - Weizmann Institute of Science
Scholarship - Bowling Green State University
Scholarship - United States Navy

#MONITORING WASTEWATER FOR TOXICANTS

Shane, Andrea L., McKinley Senior H.S., Baton Rouge, LA 70802;
5227 Riverbend Blvd., Baton Rouge, LA 70820.

A mammalian tissue culture technique has been applied to monitor for toxicants in wastewater effluents and outfalls from domestic and industrial facilities. Two cell lines-a Chinese Hamster Ovary Cell (CHO) and Green Monkey Kidney Cell (VERO) lines were exposed to varying concentrations of filter sterilized wastewater (25, 50 and 75% inclusion rates) in the growth medium. Viability of the cells was determined using the trypan blue exclusion technique, following microscopic examination of the monolayer.

In general, the CHO cells were more sensitive than the VERO cells to both types of wastewater. The industrial wastewater was more toxic than the domestic wastewater as indicated by the viability index. Inclusion of the wastewater in the medium after treatment at the plant (outfall) had less effect on the cells than wastewater before treatment (effluent). The results indicated, however, that treatment of the waste water at the plant was not completely effective, but some toxicants were still present. Microscopically, the morphology of both cell lines was altered drastically, especially in the presence of the effluent.

The domestic wastewater was passed through two filters sequentially, a 0.45 um filter to remove bacteria and 0.20 um filter to remove viruses. Viability of both the VERO and CHO cells was higher after passage through a 0.20 um filter indicating that contaminating viruses may have contributed to the death of the cells.

This technique could be utilized in conjunction with the biological oxygen demand tests, that are required at present, as a means of monitoring for toxicants in wastewaters, and as an aid in assessing the effectiveness of the water treatment facility.

#First Award - American Medical Association
Fourth Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company
Honorable Mention - National Oceanic and Atmospheric Administration
Honorable Mention - United States Air Force

ARTEMIA SALINA BIOMONITORING AS A PREDICTIVE TEST FOR TERATOGENICITY AND MUTAGENICITY IN MAMMALS.

Guthrie, David P., Barry H. S., Barry, IL 62312;
567 Williams St., Barry, IL 62312.

The purpose of this research investigation was to determine if Artemia salina biomonitoring can be used as a predictive test for chemical teratogenicity and mutagenicity in mammals.
Artemia salina biomonitoring systems have recently drawn interest as a rapid, simple technique for the determination of teratogenicity. Brine shrimp increase rapidly in length between 24 and 48 hours after wetting. Teratogenicity can be determined by comparing differences in length of control and experimental animals after the growth period. Teratogenicity was based on a 20% difference in growth between control and experimental animals.
Three substances were tested for teratogenicity using the Artemia Teratogenic test system; Saccharin, Colchicine, and Acetylsalicylic Acid.
Using results of experimentation and results obtained from literature, two statistical correlations were conducted to determine relationships of data obtained in predictive and determinative tests for teratogenicity and mutagenicity.
A correlation coefficient of .96 was found between Artemia Salina/ teratogenic testing and mammalian tests for teratogenicity. A .50 correlation coefficient was found between Artemia salina teratogenic testing and mutagenicity in the Ames Assay test
Artemia salina teratogenic test system was shown statistically to be an efficient predictive test for teratogenicity and mutagenicity.

RADIOACTIVITY 90 SR EFFECTS OF FALLOUT

Hoang, Von T., Cypress Lake H.S., Fort Myers, Fla. 33908
17226 White Water Court, Fort Myers, Fla. 33908

Strontium-90 and other fission products resulting from nuclear explosions are brought to the earth by rain and snow, and contaminate the soil. Plants growing in the soil are contaminated with this fallout and absorb the radioisotopes along with nonradioactive minerals. They incorporate the radioactive isotopes and synthesize them. If plants that have absorbed strontium-90 are eaten by dairy cows, then the milk produced for human consumption will thus contain some of these radioactive isotopes. Therefore, we may assume that some milk may be heavier in isotopes than other milk, because of the varying degrees of fallout on the earth.

Strontium-90 is a chemical similar to calcium and is retained in the bones the same way as calcium. So then, our bones are radioactive to a degree theoretically, because of the deposits of strontium-90 in them. Are the levels of radioactivity in milk really safe for human consumption?

I took milk from four different regions of the United States, (Fla., Tex., Cal., & N.Y.), boiled and charred it. Then I used a Geiger counter to measure radioactivity in the environment where the milk was produced. After this, I used the same geiger counter to measure the radioactivity of the calcium ash. I used a calibrated source to measure the total number of counts per microcurie.

After making these counts, I used photo paper and placed the calcium ash on it for seven hours of darkness and attempted to show that the calcium ash contained isotopes.

#A STUDY OF THE CHEMICAL AND PHYSICAL ASPECTS OF THE ENVIRONMENT OF ST. JAMES PARISH

Keller, Angela, Lutcher H.S., Lutcher, LA, 70071;
Rt. 1, Box 107, Convent, LA 70723.

My project is a composite of a three year study of the impact of industry on the environment of St. James Parish. My work was divided into three phases (1) solid waste (2) water from the Mississippi River (3) air analysis and my purpose was to analyze the condition of the environment of St. James Parish. My procedure was to collect samples of the environment and analyze them. For phase I of my analysis, I used Nuclear Activation Analysis to determine what elements were present and their percentages. It was found that all industries in the study area had containment systems for the waste that were well monitored and efficient. Though harmful elements were contained, these elements failed to show up in any significant level with instream analysis in the surrounding areas. Phase II of my research was done by using a Marktel Mark V Digital Water Quality Analyzer for test on pH, Dissolved Oxygen, Conductivity, and Temperature. The samples were then tested in a DR-EL/2 Spectrophotometer for Color, pH, Turbidity, Conductivity, and Dissolved Oxygen. The next test was run in the Manometric Biochemical Oxygen Demand Chamber for BOD analysis and my element analysis was run on the LSU Inductively Coupled Plasma Optical Emission Spectrometer. I found that instream pollution concentrations are relatively below the maximum level stipulated for all state and federal laws. Phase III of my research, I did test for Sulfur Dioxide on the Meloy Model SA700 Analyzer and performed test for Ozone on the Dasibi Model 1003 Ozone Analyzer. Both were below the maximum level stipulated by EPA standards.

#First Award - American Society of Civil Engineers
Second Award - General Motors ISEF
Second Award - Water Pollution Control Federation

#ACID RAIN: FOLIAR AND CELL GROWTH EFFECTS OF TWO TYPES OF ACID RAIN ON PHASEOLUS VULGARIS (BEAN PLANTS)

Wright, Wendy, Montgomery Blair H. S., Silver Spring, MD 20910; 201 Lincoln Ave., Takoma Park, MD 20912.

Experiments were performed to study the effects of synthetic acid rain on the growth characteristics of phaseolus vulgaris, the common bush bean. The first set of plants were used to compare the effect of acid rain containing sulfuric acid at pH values of 1.5, 2.0, 2.5, 3.0, 3.5, and 4.0 to a control of pH 6.0. The second set of seven groups were used to test the effect of acid rain made with nitric acid at the same set of pH values.

The plants were grown hydroponically to insure that they were not in a sulfur or nitrogen deficient enviroment. The acid rain was simulated by spraying with an atomizer every three days. Characteristics measured were plant height, leaf size, leaf damage, cell size, and internal pH.

Symptoms observed were excessive budding, shriveled stems, protruding veins, and wrinkling of the leaves. The leaves also developed necrotic lesions of varying severity. Apparently these lesions were formed when a cell's internal buffering system was overwhelmed and the cell's pH was lowered below 4.0. Another major effect was stunted leaf and stem growth. Contrary to other published research, microscopic observation showed that bean cell size was smaller in the acid treated plants. This suggested that growth stunting was due to lack of cell expansion.

*First Award - U.S. Department of Energy
Third Award - General Motors ISEF

#DOES ACID RAIN AFFECT THE ENVIRONMENT?
(A CONTINUING STUDY)

Beck, Douglas S., Rockledge High School, Rockledge, FL 32955
1120 Geiger Street, Rockledge, FL 32955

Acid rain, composed of sulfur dioxide and nitrogen oxides, has been called the "environmental time bomb" of the 1980's. This rainfall is contaminated by industrial pollutants and becomes so acid-like that it can be harmful to our environment and human health. Efforts must be made to determine what affect acid rain has on the environment of Florida.

This researcher furthered the study of acid rain by conducting a series of experiments: (1) established collection sites for rain water and tested for acidity level; (2) exposed 18 Japanese Medaka fish embryos to collected rain water; also established a control group; (3) exposed 10 oak seedlings and 12 fish to .14 ppm sulfur dioxide (SO_2) in Lab A; (4) exposed 10 oak seedlings and 12 fish to locally collected rain water in Lab B; (5) established a control group in Lab C; (6) conducted a survey by mail of seven regional areas of Florida regarding acid rain/coal or oil burning power plants.

Results from tests conducted on fish embryos indicated a definite correlation between low pH readings and unborn or mutated fish. In addition, results from tests in Lab A indicated SO_2 did have a significant affect on fresh water fish and oak seedlings; data collected from Lab B indicated rainfall in this area does have a low pH reading and can affect the growth rate of fresh water fish and oak seedlings. Although the survey was inconclusive, a previous survey of locations within this county strongly indicated environmental problems associated with power plants in the vicinity. CONCLUSION: Acid rain is a serious environmental problem in Florida.

#Alternate Award - U.S. Department of Energy
Honorable Mention - National Oceanic and Atmospheric Administration

#DETERMINATION OF LACUSTRINE TROPHIC STATE

Wentworth, Eric C., Kathleen H.S., Lakeland, FL 33803
420 Howard Ave., Lakeland, FL 33801

Eutrophication is the natural and/or cultural aging process that is associated with most lakes. The three basic stages that lakes will go through during their life span are called oligotrophy, mesotrophy, and eutrophy. Oligotrophy is the first stage and is characteristic of young lakes with low energy levels and high water clarities. Oligotrophic lakes are generally deep bodies of water with hard, sandy bottoms. Mesotrophy, the second stage, describes lakes in their "middle stages of life" in which water clarities are somewhat decreased and depths are shallower due to organic matter settling to the bottom. A lake in the eutrophic stage becomes very shallow and exhibits extremely reduced water clarity. Large amounts of organic matter (due to algal sedimentation) often accumulate on the bottom.

There are various physico-chemical parameters that can be used to determine the trophic state of a lake. Considering the high number of eutrophic lakes in Florida, careful assessment of trophic state is of great importance. The principle variables of importance in this study include Secchi transparency (a measure of water clarity), total phosphorus and total Kjeldahl nitrogen (primary nutrients), and chlorophyll a (a measure of algal biomass). Carlson's index has been used to quantitatively determine trophic state for fifteen lakes in the Ocala National Forest. Data of this type are useful aids in lake management and restoration programs.

#Third Award - Bureau of Reclamation/U.S. Department of the Interior
Third Award - General Motors ISEF

#ATMOSPHERIC SULFUR TRANSFER AND DEPOSITION IN SOIL AND RAIN

Kieffer, Heidi J. Bountiful H.S., Bountiful, Utah 84010
1246 Cassidy Circle, Bountiful, Utah 84010

This two year project involved the study of sulfate-sulfur levels in various soil and rain samples taken from the north end of the Oquirrh mountains in Utah, near a smelter which emits SO_x and NO_x compounds. Soil samples were collected from seven sites and tested for Soluble Sulfate-Sulfur concentration using the acetate technique. The results of these tests prompted rainfall analysis. Rainfall (collected from July 23, 1983 to November 1, 1983) was analyzed for hydrogen ion concentration using a standard pH meter and for Soluble Sulfate-Sulfur using the acetate technique. The sulfate-sulfur concentrations in the soil varied from 800 ppm to 190 ppm. When compared to a standard value of crop growth inducing sulfate-sulfur level of 9 ppm, the concentrations are abnormally high. The total sulfate-sulfur deposited in one rainfall at one site varied from 0 g to 2500 g. The pH of the rainfall varied from 8.7 to 5.8 (.91 units higher than the theoretical pH of "acid rain") and 23.2% of the 112 samples were either neutral or alkaline. There doesn't appear to be a correlation between pH and sulfate-sulfur concentration in the rain. The alkaline rain may be due to alkaline earth elements picked up off the salt flats. The effects of the high sulfate-sulfur levels on the environment have not yet been determined, but erosion in the area of the smelter is extensive.

#First Award - American Society of Agronomy
Fourth Award - General Motors ISEF

LEAD CONTAMINATION IN SOIL DETERMINED B ATOMIC ABSORPTION SPECTROPHOTOMETRY

FELIU RAEZ, JOSE M., MIGUEL M. MUÑOZ SENIOR HIGH SCHOOL, CAYEY, P.R.

BOX 5162, CEC STATION, CAYEY, P.R. 00633

In Puerto Rico there is a severe problem related to the contamination of environment with lead. Approximately, two out of three cars consume gasoline with lead additives, as compared to a one-to one ratio in the United States. Vegetable plantations are exposed and cattle grass at distances close to the roads. Even if small amounts of lead are ingested, inhaled or absorbed, the effects will be manifested years later due to the irreversible accumulation of this element in the human body.

The purpose of this investigation is to determine the contamination of lead in soil, as related to the flux of motor vehicles near roads of different traffic densities. Soil samples were taken at perpendicular distances of 3, 10, 20, 33, 66 and 100 meters from several representative roads. All the samples were taken at the same hour in sunny days. After being processed chemically, the samples were analyzed using an atomic absorption spectrophotometer.

The results demonstrated that the quantity of lead generally increased in inverse proportion to the distance from the road and in direct proportion with the traffic density.

Samples of water and vegetation were analyzed in order to correlate the results. No lead contamination was found in water and the presence of lead was lower in vegetation than in soil.

It is hoped that with the results of this research the citizens and the government will become aware of the dangers of consuming gasoline with lead additives.

#AN INQUIRY INTO THE FACTORS AFFECTING THE GROWTH OF A FOREST

Luthy, Brian H., Black River H.S., Sullivan, Ohio 44880; 44733 Stewart Road, Sullivan, Ohio 44880.

The objective of this project is to develop a system to determine a forest area's deficiencies through the study of individual trees and their ecological growth factors by comparing the optimum theoretical ecological growth factors of forest ecology with the actual observable ecological growth factors of a forest. To accomplish this, prime specimens from eight different tree species will be studied by observing and recording their individual climatic, soil and biotic factors.

To tabulate the results and to draw conclusions, each factor to be studied will receive a determined number of points so that a numerical analysis can be performed. These points will range from zero to three, with zero points corresponding to a tree's deficiency within a certain factor area, while a three corresponds to an optimum growth range for that factor.

Next, the total points from an individual tree will be compared with the key for that species, which contains the optimum theoretical points which that species may possess. These optimum theoretical points were determined through literary research. In this manner, an individual tree's weakest factors may be determined, and by comparing the weakest factors from all the trees in the same general vicinity, a conservation measure may be chosen and taken to improve the forest's site index (growth rate).

#Fourth Award - General Motors ISEF

THE EFFECTS OF ACID RAIN ON THE PROTEIN CONTENT OF PHASEOLUS LIMENSIS AT VARIOUS DEVELOPMENTAL STAGES

Ramsey, Sematha C., D. M. Therrell High School, Atlanta, GA 30331
3680 Barrow Place, S. W., Atlanta, GA 30331

The purpose of this project is to determine the effects of acid rain on the protein content of Phaseolus limensis at various development stages.

The procedure involved filling germinating chambers with potting soil. The seeds were soaked in a 2% hypochlorite solution for 10 minutes. The seeds were planted at 1,3,5 and 8 day intervals. Control and experimental groups were established. The simulated acid rain had a pH of 5. The plants were watered with 100 milliliters of water or simulated acid rain. A standard protein solution was made from albumin borine. The plants from each developmental stage were crushed in distilled water. Eighteen milliliters of plant extract were placed inside a test tube and buffer added. The color was observed and measurements made on a colorimeter. A blank control was placed in the colorimeter and the percent transmitted was calculated and compared with each sample. The results showed a higher percent of protein present in the control when compared to the experimental plants.

I thus conclude that more protein is present in the control plants. The experimental plants showed more protein in earlier developed embryos which contrasted with the control, which showed more protein in the later or older embryos.

#THE ENVIRONMENTAL EFFECTS OF HIGH VOLTAGE POWER TRANSMISSION

Ford, D. Brian, Duncan H.S., Duncan, OK 73533
1002 Alpine, Duncan, OK 73533

High voltage powerlines are hazardous to the environment because of the harmful discharges they produce. Such things as electrical fields, inductive and capacitive charging of metallic objects near the lines, radio noise, radiation emission, ozone, coronas, and static charges are examples of environmental effects. These effects may be produced by high voltage transmission systems found throughout most areas. Because of the high usage of electrical power, these discharges are commonplace and may present problems to our environment. This project provides organized data that illustrates the measurements of discharges from power systems in and near my hometown. The purpose of this project is to identify the environmental effects of high voltage powerlines and to suggest potential solutions to the problem. These effects are illustrated by discharges on plant life from simulated powerlines demonstrated in my project. The plant growth comparisons were observed and the results recorded in my log book. Under simulated conditions in the experiment, plant life was stunted from the high voltage exposure. Actual measurements were taken and observations made weekly of the live plants planted under high voltage powerlines. Readings are also recorded in the log book of induced voltage and current in wire fences running parallel to powerlines, and of electric field voltages in the area. My project demonstrates that parallel ground wires located beneath powerlines reduce the discharges and help eliminate the harmful effects.

#First Award - American Veterinary Medical Association
Third Award - Junior Engineering Technical Society
Fourth Award - General Motors ISEF

ACID RAIN: HOW DOES IT EFFECT OUR PLANT LIFE?

Jenkins, Tammy M., Palatka High, Palatka, Florida 32077
P. O. Box 1005, San Mateo, Florida 32088

The purpose of this experiment is to show acid rain's effects on plant life from the surrounding area and how acid rain affects our environment in general.

The materials and equipment used included three types of plants (three of each type), potting soil, plant pots, three sprayers, H_2SO_4 (sulfuric acid), HNO_3 (nitric acid), tap water and various samples of rain water, a photomicrophragh, Peters special, PH paper and 100 speed 35mm film.

The first step in the process followed was to pot the plants and see that they were healthy. After they had grown for about two weeks the acid treatments were started. Pictures of plant cells before treatment and after treatment were taken. During this time, rain water was also collected to compare with the acidity of rain two years ago.

The results that have been reached during this testing period were certain acids PH's affects plant life and the environment in general. Some effects were the damaging of leaf tissue, discoloration of the plant in general and loss of structured support. The rain water tested in our area shows a definite drop in PH from two years ago.

The practical uses for studying acid rain are to see its affects on the environment and learn either how to use the affects for our benefit and/or to quell its harmful affects. Studying this topic is a necessity if there is to be any control or understanding of our environment and how man changes it.

#STUDIES ON POSSIBLE ECOLOGICAL EFFECTS OF TWO-CYCLE MARINE ENGINE EXHAUST

Gann, Melanie E., E.D. White Catholic H.S., Thibodaux, LA 70301
431 Easy Street, Thibodaux, LA 70301

The initial idea of this project was to determine the toxicity of outboard engine lubricant on green algae. Some success with lubricant eventually led to the formulation of "synthetic" exhaust water, which, in turn, led to the use of actual two-cycle engine exhaust water as the test substance. Toxicity was determined by means of the standard bottle bioassay technique and was measured in terms of a decrease in maximum standing crop. Scenedesmus quadricauda and Ankistrodesmus sp were used as the test organisms.

The effective concentration - 50% (EC 50) for Scenedesmus quadricauda was found to be 3.75% exhaust water; for Ankistrodesmus sp 3.1% exhaust water using the bottle technique.

Suspecting that evaporation of volatile components was affecting the results, a flow-through system was improvised utilizing the characteristics of a devise called a Biomonitor. Use of the Biomonitor lessened the influence of evaporation, and the EC 50, using this improvised flow-through system, was found to be 1.4% exhaust water using Ankistrodesmus sp as the test organism. Mixed populations of various algae gave an EC 50 of 1.28% exhaust water.

An attempt was then made to determine the actual effects of evaporation. Exhaust water, aged 11 days, was used as the test substance. An EC 50 of 6.4% for Ankistrodesmus sp and an EC 50 of 7.9% for the mixed populations were found.

The contributions of this project are twofold. (1) The toxicity of two-cycle marine engine exhaust was found to be considerably greater than reported in the literature; however, aging greatly decreased toxicity. (2) The benefit of a flow-through bioassay technique utilizing the Biomonitor was demonstrated.

#First Award - U.S. Department of Energy
Third Award - General Motors ISEF

#THE EFFECT OF MOLTEN NACl-$AlCl_3$ ON COAL FLY ASH

Becker, Royal M., Davenport Central High School
Davenport, IA 52803
2306 Fairhaven Road, Davenport, IA 52803

Research has been conducted at the Ames Laboratory over the past few years to investigate the recovery of metals, primarily aluminum, from fly ash by chlorination. Fly ash is comprised of about 50% silicon, 20% aluminum, 10% iron, and about 1.5% titanium. Fly ash is a waste product that comes from the burning of coal. The major problem with the chlorination process is that the reaction rate of fly ash is very slow. Previous testing indicated that using a fused salt media for reaction would cut time off the chlorination process. The problem dealt with in this experimentation is to determine the effects that fused salt has on fly ash.

In this work, sizing data and SEM photographs were taken of the fly ash; X-Ray Diffraction studies were done; and, the fly ash was also leached in HCL and with a fused salt ($AlCl_3$-NaCl) solution. The basic procedure used a fused salt treatment, which involved mixing the fused salt and fly ash at a very high temperature. The treated fly ash was, then, analyzed by atomic absorption spectroscopy.

Only the fused salt treatment provided results that showed that the fly ash was affected. These tests showed that iron was definitely affected; i.e., some iron loss, while aluminum was not affected. Therefore, this conclusion was reached: experimentation using a fused salt in the chlorination process does not affect the yield. As a future result, therefore, recovery of strategic metals from fly ash will cut our metal import need.

#Honorable Mention - United States Army

#DETERMINATION OF DIGESTOR THRESHOLD LIMITS FOR METALS IN SEWAGE TREATMENT

Thompson, Marilyn, Central High School, St. Joseph, MO 64501;
2605 Gene Field Road, St. Joseph, MO 64506.

Knowing the limits of any biological waste digestive system is necessary to effectively reduce waste pollution. Heavy metals can inhibit the aerobic and anaerobic microbial digestors, resulting in decreased breakdown of wastes. The EPA has published threshold limitations for metal concentrations entering digestive systems. They do not, however, take the fact that every system is different into consideration. Their figures are based on data derived from lab models which do not reflect the characteristics of individual systems since the microbes have the capability to adapt.

In this research, sludge from the city treatment plant was digested and analyzed for heavy metals by Inductively Coupled Plasma. The initial amount of microbial life was determined by centrifuging a sample of sludge and preparing the supernatant for analysis of adenosine triphosphate by ultraviolet spectrophotometry. The sludge was spiked with increasing levels of heavy metals and the ATP absorbance was rechecked. A 25 percent decrease in microbial life indicated the metal concentration was hazardous to the system.

The results should indicate the limitations for the particular system. Industries may not need to spend as much money for pretreatment of their wastes if the digestors can tolerate higher concentrations of metals. Waste will still be effectively broken down, preventing the release of pollutants into the environment.

#Second Award - United States Air Force
Third Award - American Society of Civil Engineers

DIOXIN

Jameson, Jaysn, Early H.S., Early, Texas
P.O. Box 3105, Early, Texas 76801

In the summer of 1983, an Illinois jury awarded 47 railroad workers nearly $58 million in damages for illnesses resulting from their exposure to Dioxin in 1979, when a tank car ruptured near Sturgeon, Missouri, spilling a dioxin-contaminated solvent.

A sample was obtained, collected approximately 130-140 yards from the accident site. The dioxin in the soil is now 4 years in half-life decomposition; thus if the original sample is considered as unit 1, then on a half-life of 1 year, the soil will contain 1/16th of unit 1. Clean-up of the site consisted of removal of top soil and shipment of contaminated soil to Wright City, MO. and Kansas.

Reference literature indicates that there is no safe and reliable way to clean-up Dioxin in the environment.

Utilizing the soil-test sample, biological environments were established to test if a biological contaminate was present in the soil sample.

Experimental evicence showed that with increased quantitative additions of the sample soil, into the test biological environments, the soil produced harmful effects to the organisms (developing corn and bean plants; Euglena gracilis; Ebony, Dumpy, and Apterous fruit flies) tested, except for certain non-pathogenic bacteria (Escherichia coli, Bacillus subtillis, Serratia marcescens, Bacillus cereus) which showed increased growth patterns.

In conclusion new guide-lines for Dioxin clean-up procedures should be investigated, perhaps including biological environmental testing to improve the reliability of the clean-up techniques.

POLLUTION IN OYSTERS

Knorr, Craig M., I. C. Norcom H. S., Portsmouth, VA 23707
415 Leavell Road, Portsmouth, VA 23701

This project was intended to analyze the concentrations of Pb and Cd from the Nansemond River(Pig Point) and to compare the concentrations of 1983 vs. those of 1984.

Experimental and control oysters were obtained, shucked, and washed. After the excess water was removed, the samples were weighed and prepared for spectrophotometry by digestion in Nitric acid. The samples were analyzed by either flame or atomic absorbsion spectrotometry. By studing the data, concentrations were calculated by using: the curves, the sample weight, extent of dilution, and the amount of acid added. The resulting concentrations were compared against each other: Experimental vs. Control, and '82-'83 vs. '83-'84. A pretested oyster sample from the National Bureau of Standards was obtained to test the accuracy of the experiments.

After reviewing the data of '82-'83 vs. '83-'84, it was observed that the highest concentrations were in the experimental oysters. The following results were obtained:

Experimental oysters,
Cd conc.-'82-'83 x=7.34ug/g
'83-'84 x=10.3ug/g
Pb conc.-'82-'83 x=0.68ug/g
'83-'84 x=15.3ug/g

Control oysters,
Cd conc.-'82-'83 x=3.50ug/g
'83-'84 x=6.13ug/g
Pb conc.-'82-'83 x=0.02ug/g
'83-'84 x=0.47 ug/g

NBS standard,
Cd conc.-'83-'84 x=4.03ug/g
Pb conc.-'83-'84 x=0.47ug/g

Since a standard was not used for the '82-'83 samples, their concentrations cannot be considered valid.

THE EFFECTS OF SIMULATED ACID RAIN ON THE ENVIRONMENT: PHASE III

Self, James L.
Stringtown High School
Box 27
Stringtown, OK 74569

Wheat, radishes, soybeans, concrete, and bricks were used to study the effects of acid rain using simulation studies, plus soil leaching and soil composition tests. Beans, radishes, and wheat were planted, watered once a week with acid water, and measured for growth rate. Biggest change was in the size of beanpods and beans. Below pH4, their size was drastically smaller. Wheat at lower pH's had yellowish blades, and radish leaves were smaller. Poured acid water over bricks and concrete once a week. Results were slow, so took chips, weighed and placed in acid water. I set up a second experiment group with uniform size and mass. I took pH readings every 12 hours. After 2 days, poured off water and started again. I did this 12 times and graphed results. Weight loss in concrete was very noticeable and probably due to the cement reacting with acid. Bricks showed little pH change over 12 days and no weight loss. Greatest change in pH from the original was during the first 12 hours. Soil leaching and soil composition studies showed lots of materials being leached. Group I was fed acid water for 17 months and Group II for 7 months. All leached Fe, PO_4, NO_3, and the soil became more acidic, except for control and plant food. Growth has slowed with brown spots on leaves of Group II. Also, Ca and CO_3 are leached. My conclusion is that acid rain is a threat and further studies will bear this out.

#A STUDY OF THE ACID PRECIPITATION PHENOMENON AND ITS ECOLOGICAL CONSEQUENCES IN PUERTO RICO

Moreno, Edgar, C.R.O.E.M. High School, Mayaguez, P. R. 00708;
Bo. Puntas, Bzn. 197, Rincón, P. R. 00743.

Acid rain is produced by environmental contamination. The principal components that help in the formation of acid rain are sulfur dioxide and carbon monoxide. When this components ascend to the air they form sulfur oxide and nitrogen oxide which are the principal components of acid rainfall. Acid precipitation comes in the form of water, snow and sleet.

During tips around the coasts of Puerto Rico, some rain water, and soil and aquatic ecosystems water samples were collected. The wind velocity and the sulfur dioxide concentrations were also measured.

The principal objectives of this study were: (1) to investigate if there is acid precipitation in Puerto Rico; (2) to find a relationship between the contamination sources and the stations studied; (3) to experiment with aquatic organisms and terrestrial plants to observe the effect of acid precipitation on them; (4) to investigate the pH of soils, sands and aquatic ecosystems in the stations and (5) to measure wind velocity and concentration of sulfur dioxide in the air of all the stations.

The study showed that acid rainfall is falling in Puerto Rico in Cataño, San Juan and Dorado. A relationship was also found between the contamination sources and the pH of 5.6 and under. Some of the stations have a pH that affects the organisms living there. Some of the coastal soils are not recommended for agriculture becuase of their pH probably aided by acid rainfall.

#Third Award - General Motors ISEF
Alternate Award - U.S. Department of Energy

ECOLOGICAL EFFECTS CAUSED BY THE FLOODING OF THE GREAT SALT LAKE AREA

Barrett, Stacie L., Weber High, Pleasantview, UT 84404
3081 N. 1225 E., North Ogden, UT 84404

New flooding of the Great Salt Lake in Utah can have potential consequences in relationship to the environment and ecological factors, particularly if salinity content in the lake continues to drop, and the prolonged submergence of newly flooded soils affects the rate of life growth.

Last year, due to record snowfall and fast melt-down, flooding occurred around the Great Salt Lake area. This year has also brought record snowfall and will also most likely bring flooding.

In order to determine potential consequences the flooding would have on animal and plant life I devised tests which would provide an analysis on the over-all affects it would have on selected specimens that rely on the environment provided by the Great Salt Lake. The changing salinity percentage in the lake caused me to investigate what affects this might inflict upon the brine shrimp population which resides in the lake. Since composition of the soil sediments are also being affected I chose to investigate actual soil samples taken from the lake for observation for life growth in the soil.

My problem: How will flooding around the lake affect animal and plant life in relationship to the salinity content in the lake and newly flooded soils? My hypothesis: If salinity content in the lake continues to drop the brine shrimp population will decrease and the prolonged submergence of newly flooded soils will cause plant life to be affected.

In conclusion I found that due to the dropping salinity content in the lake the brine shrimp population will increase and that the newly flooded soils cause life growth around the area to be affected.

#JUVENILE HORMONE ANALOGUES AS INSECTICIDES

Levine, Patti J., Edward R. Murrow H.S., Brooklyn, N.Y. 11230
1972 E. 29th St., Brooklyn, N.Y. 11229

Juvenile Hormone is produced in the corpora allata gland of the insect. This secretion controls its moulting. If we can tap into the insect's hormonal system, we could biologically control the insect. This project focuses on the use of such substances, Juvenile Hormone Analogues, as potential insecticides.

If we are to test the effectiveness of a substance as an insecticide we must test it in two different aspects; the first being on the insects, and the second being its toxicity to the environment. This project covers both of these aspects.

I first incorporated two JHA's, ZR515 and Farnesol, into the food medium of populations of Drosophila and tested for their effects on puparium formation, eclosion, and the life span of the flies. I also introduced these analogues into the food medium of populations of E.Coli. Finally I incorporated these analogues into the soil to test their effects on the soil Microorganisms.

JHA's prevented new generations of Drosophila from developing. The pupatorium remained dormant in the vials and never hatched. The life span of the flies was not affected by the ZR515 but was drastically reduced by the concentrations of Farnesol. Both analogues proved to be non-toxic to the environment in that they did not destroy helpful colonies of E.Coli and soil Microorganisms. Equal bacterial growth was recorded in both my control and experimental groups.

My results indicated a definite possibility for JHA's as insecticides. They prevented new generations of Drosophila from developing while not harming the helpful Microorganisms. JHA's may truly be the insecticides of the future.

#Fourth Award - General Motors ISEF

NOTES ON THE BIOLOGY OF TURTLE GRASS, THALASSIA TESTUDINUM KONIG IN PUERTO RICO.

Santana, Angel E., Dr. Pedro Perea Fajardo H.S., Mayaguez, P.R. 00709;
Reparto Universidad Calle 4 L-22, San Germán, P.R. 00753.

Thalassia testudinum König or turtle grass is a marine angiosperm, that with various associated species, form a charcateristic assamblage, known as turtle grass meadows, on sandy and muddy bottoms. This plant is the most dominant of the marine grasses of Puerto Rico. This paper is an attempt to consider some aspects of its ecology on island waters emphasizing the effects of pollution on this plant and postulating the use of the large biomass that the sea puts ashore daily as a possible source of energy.

To carry out this study 5 stations were selected along the southwestern coast of the island. The environmental parameters affecting this plant were determined. A chemical analysis of the plant in each station was carried out to determine water, organic matter and mineral content. The same was done for the substrate. The growth of the plant in each station was also determined as well as the percentage of browsing.

To determine the effect of contaminants such as urea, DDT, Gasoil, Rinso and Vel on the plant, the organism was subjected to concentrations of 1%, .1%, .01%, .001% and fresh sea water as a control. The effect of the pollutants was determined by checking the liberation of O_2 bubbles as the plant is forced to carry on photosynthesis. Urea turned out to be the worst pollutant.

A determination of how many tons of Thalassia per acre are produced on each station. The amount of biomass thrown by the sea on one station was calculated. The amount of methane gas produced by this biomass through fermentation was calculated and a good yield was obtained.

SPIROGYRA: THE ENVIRONMENTAL ALGAE

Rhonda K. Methvin, Grants H. S., Grants NM 87020
P.O. Box 2364, Milan NM 87021

United States citizens have recently realized that the world is in an environmental crisis. Sewage, detergents, pesticides and other chemical residues have changed sparkling rivers into foul-smelling sewers.

The intent of this project is to use the alga, Spirogyra, to remove contaminants, especially sulfates and nitrates, from sewage contaminated water and to determine the effects this has on the chemical equilibrium of the water.

Four areas were chosen along the San Jose Creek and water samples were collected. Quantitative analysis was run on all the samples to determine the amounts of sulfate, phosphate and the nitrate contamination. Chemical analysis was performed to determine the bacteria count, dissolved oxygen content, total suspended solids and the pH of the water.

300 grams of the alga, Spirogyra, was placed in 7570 ml of water from each area. After time periods of six, twelve, twenty-four, thirty-six and forty-eight hours, each sample was run through the quantitative analysis to dtermine the new amount of sulfates, phosphate and nitrate. Chemical analysis was run to determine the effects the algae and the removal process of the contaminants had on the water.

The best absorption period was six to twenty-four hours for the contaminants. The bacteria counts and dissolved oxygen content increased. Total suspended solids were reduced. The pH remained stable.

The levels of sulfate, nitrate and phosphate were brought down to safe levels for human consumption, and the effect of the algae on the chemical equilibrium was not harmful to the water. With further experimentation, algae may provide an effective and cheap product to use in removing contaminants from water.

ENVIRONMENTAL STUDY OF SNOW FLEAS

Campbell, Tonya M. Austin High School, Austin, NV 89310
P. O. Box 178, Austin, NV 89310

Purpose: To find more information about Snow Fleas.
Procedure: Six areas were observed. The time, weather conditions, elevation, vegetation, number of fleas in a two foot radius where the fleas were noticed, depth of snow, and the temperatures of the air and snow were all considered in my observations. The elevation was found on contour maps. The depth of the snow was calabrated in inches. The temperatures were taken by a Fahrenheit thermometer, and the temperature of the snow was taken by putting the thermometer into the snow.
Results: More snow fleas were found in the higher elevations. All were found above 6,000 feet. It is cold up high but they enjoy the sun. When the sun is out they stay on the shaded side of sagebrush or in depressions in the snow, such as footprints. They are most likely to be found near sagebrush or grass, mainly sagebrush. In one observation they were found on decaying wood. After it snowed, dead snow fleas were found on the surface of the snow. Smaller fleas appeared as it grew warmer. They are found on the surface, or ¼ inch beneath the surface. Plant materials are blown by the wind from near by plants, such as the sagebrush. The fleas come out when the weather conditions are good.
Conclusion: Snow fleas are not fleas, they are springtails. Their scientific name is Achorutes nivicolus. They are in the order Collembola. The snow flea is an insect that is not commonly known about. They do not have wings.

BACTERICIDES FOR AUSTIN SCHOOL

Rusert, Pauline E., Austin High School, Austin, Nevada 89310
P. O. Box 181, Austin, Nevada 89310

QUESTION: What are the affects of selected antibiodics and disinfectants on bacteria from Austin High School?
HYPOTHESIS: I think that the Penicillin G., Streptomycin, and tetracycline will do the best. The BH-38 pineoil, and chloramphinicol will do okay, and the ammonia will not do well.
PROCEDURE: Make nutrient agar, place in autoclave for 15 min. at 15 pounds pressure. Four plates. Innoculate plates. Incubate plates. Make sub-cultures from original cultures. Make nutrient broth, sterilize in autoclave as before. Innoculate test tubes from subcultures, incubate. Using sterile cotton swabs, make lawns of bacteria on nutrient agar. Place discs with disinfectents and antibiodics on plates, incubate. Make gram stains. Identify bacteria. Take lawns out of incubator, and measure zones of effectiveness in m.m.
RESULTS: Bacteria grew better at room temperature than at body temperature. Results of zones of effectiveness: S26-large-TE-30 and P10, medium-BH-38,C30, small-P.O., S10, A; P19-large-S10,C10,TE-30, small-A, P.O., BH-38, P10; I10-large-P10, TE-30, Medium-C30, S10, A, BH-38, small-P.O. C4-large-C30, S10, medium-BH-38, small A, P.O., P10, TE30. B3-large-C30, S10, P19, TE30, small-A, P.O., BH-38.
CONCLUSION: Overall, TE-30, C30 and S10 worked the best. P10, BH-38 worked okay, and A and P.O. were the least effective.
ABBREVIATIONS: C30-chloramphinicol; S10-streptomycin; P.O.-pineoil; A-ammonia; BH-38-degreaser; P10-penicillin G.; TE30-tetracycline.

DEADLY WATER: COLIFORM COUNT AND IDENTIFICATION

Stevens, Lori, Millard H.S., Fillmore, Utah 84631
Box 105, Holden, Utah 84636

The culinary water in Holden, Utah has not passed Utah State Health Department requirements for several years. A procedure was outlined to count and identify coliform bacteria present in culinary water. Twenty 100ml samples of water were taken at various locations in the town. These samples were then filtered and plated on MF Ends agar. They were incubated and characteristic colonies were counted. Seven subcultures were made and these seven organisms were specifically identified. All were pathogenic.

The main source of contamination appears to be occurring at the town's main collection site. Secondary contamination is possibly occurring in supply lines.

DOES WEATHER INFLUENCE OUR LIVES?

Capp, Valerie K., South Shore H.S., South Shore, SD 57263
Rte#1 Box 160A, Twin Brooks, SD 57269

This project was designed to see if weather influences our crop and livestock production in South Dakota. Information was collected from the South Dakota Crop and Livestock Reporting Service and the United States Department of Commerce (Weather Bureau).

Data consisted of historic crop and livestock production estimates from the 1880's to 1982 and climatic summaries from 1870's to 1982. Analysis was conducted through inspection of graphs which compared crop and livestock production with yearly precipitation and average annual temperatures.

My analysis revealed that years of warmer temperature and lower precipitation are followed by years in which crop and livestock production decreases. Crop and livestock production rises in years following cooler years.

With these results, I concurred that the weather does influence our crop and livestock production to a certain extent. Other factors may also influence our crop and livestock production.

#EFFECT OF PCBs ON VIABILITY AND MORPHOLOGY OF DROSOPHILA MELANOGASTER

Lansdale, Stephanie L., C. E. Byrd High School, Shreveport, LA 71104; 1850 Victory Drive, Shreveport, LA 71104.

PCBs have been documented as toxins to various organisms, including humans. This experiment studied the effects of ingested PCBs on the viability and morphology of Drosophila melanogaster. Drosophila melanogaster was subjected to PCBs in these concentrations: 5 ppm (0.01 ml/10g of food), 50 ppm (0.1 ml), 100 ppm (0.2 ml), and 500 ppm (1.0 ml). In the highest concentration no flies developed. The study showed a decrease in the number of offspring and an increase in two morphological defects (wing and tergite deformities), both in proportion to the amount of PCB ingested. Crossing the F_1 flies showed that the wing deformity noted was transmittable. The effects did not seem to be unique to either sex. The wing malformations were mutagenic in nature and appeared to be caused by a recessive gene.

#First Award - United States Army
Second Award - General Motors ISEF

*ACID RAIN: CAUSES, EFFECTS, CURES

Thomas, Leslie S., Canterbury School, Ft. Myers, FL 33907
5471 Beaujolais Ln. Ft. Myers, FL 33907

This three step experiment was designed to first, find the causes of acid rain, second, to show that acid rain has an effect on the ecosystem, and third to find methods to stop the acid rain, and to find solutions to correct the damage that has all ready been caused by the acid rain. This researcher has done these experiments over a period of six years, with each year the study becoming more in depth.

This researcher went about these experiments in numerous ways. To investigate my first hypothesis, this researcher did research ranging from reading to personal interviews. To prove my second hypothesis this researcher exposed white mice to sulfuric acid with a pH of 3.5, and studied the effects. This researcher also tested different metals and building materials in an acid solution of the same pH, and studied the effects. In addition this researcher did on site research in the Adirondack region of upstate New York, to examine the overall effects of Acid Rain.

The third part of the hypothesis was done by both research and experimentation. The experiments done here were to test the neutralizing effects of different substances on acid, and to find a better substance to neutralize the acid lakes.

This experiment shows the full circle of the acid rain problem! The Causes, Effects, and Cures.

*First Award - General Motors ISEF

DETERMINING EFFECTS OF ACID PRECIPITATION ON ENVIRONMENT WHY IS ACID RAIN HARMFUL?

Borzoni, Marcella M., Wilcox H.S., Santa Clara, CA 95051
4625 Lakeshore Drive, Santa Clara, CA 95054

Acid Rain is precipitation below 5.6 pH - fresh waters acidified below a pH of 5 are found in Southern Norway & Sweden, Britain, Netherlands, East Germany, Canadian Provinces of Nova Scotia and Ontario; Northern New England, the Adirondacks and Florida. The pH of human blood is in the range of neutral - 7.4. This project deals primarily with the effects of acid rain on plant leaves (specifically chrysanthemum, geranium, begonia, apple mint, strawberry, poplar, redwood sorrel) which displayed damage in controlled experiments. Research indicates that minimal concentrations of sulfuric acid affected chlorophyll and interferred with photosynthesis, but leaves were protected from immediate damage to stomata and epidermal cells by their wax, which subsequently broke down, and stomata and epidermal cells were observed collapsing. Vascular tissue escaped. Other experiments and observations showed adverse effects to common building stones (argonite, dolomite, limestone, marble) and soils; and research indicates fish populations, as well as other life forms, are suffering and systematically being eliminated. Acid Rain is detrimental to all parts of our living environment and should be controlled and/or prevented at all cost.

#RADIOLOGICAL IMPACT OF COAL FIRED POWER PLANT EFFLUENTS...ASSESSED BY HIGH RESOLUTION GAMMA SPECTROSCOPY AND STANDARDIZED THEORETICAL DOSIMETRY TABULATIONS AND ASSUMPTIONS

Amsel, France D., Spruce Creek H.S., Port Orange, FL 32019; 183 Moonstone Ct., Port Orange, FL 32019

Our growing population's increase in the demand for energy has called for increases as well in the combustion of coal as a means of obtaining it. It has been noted that the combustion of coal has a concentrating effect on radioisotope levels in coal ash.

Crystal River Power Plant coal ore and ash samples were collected and assessed by gamma spectroscopy. Through the collection of various data concerning Gaussian dispersion equations, dose conversion factors, meteorological data, stack height, and several theoretical assumptions, dosimetry tabulations were performed. Since the scope of this project ended up somewhat limited to the type of coal used at Crystal River and to its specific clime, a computer program was written to assess dosimetry from imputed variables. This program could in turn assess individual dosages for any given site regardless of coal type, as long as various statistics such as stack height, annual coal combustion, ash release, and meteorological data were known. Imputed variables for model stacks would then give us a general and less limited overview of radiological impacts resulting from the release of radioactive effluents than from individual site assessements.

#First Award - U.S. Department of Energy
Fourth Award - General Motors ISEF

#TOXIC SUBSTANCE UPTAKE - THREE YEAR INVESTIGATION INTO THE ABSORPTION, TRANSPORTATION, AND STORAGE OF LEAD IN PLANTS

Woodward, Mandy, Brush High School, Brush, CO 80723
27444 Rd. Y. Snyder, CO 80750

Lead is one of the heavy metals whose harmful effects at high doses have long been known. It is introduced into our environment through such common things as lead paint, gasoline additives, and junked batteries. This project was developed over three years to investigate the absorption, transportation, and storage of toxic substances (specifically lead) in green plants. Mung beans, corn, and Coleus were used in the experiments. The following experiments were performed: lead and mercury absorption through the soil and hydroponically, atmospheric lead absorption, exhaust condensate exposure, absorption affected by pH, exposure to lead radioisotope, lead's effect on leaf fall, and regeneration. The following analyzation techniques were used: chemical (Hach kit), microscopic, microprocessor ionalyzer, chromatographic, and radioactive. From this project, it was determined that plants absorb lead through their root systems and not through their leaves. The lead is stored within the roots and stems. It was also determined that pH affects the absorption rate of lead. This investigation opens the doors for further experimentation with lead and its effects on plants.

#First Award - American Society of Agronomy
Fourth Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

ACCLIMATION OF *LACTOBACILLUS* TO SEWAGE FOR THE INCREASED PRODUCTION OF LACTIC ACID

Johnsen, Sonya L., Buena High School, Sierra Vista, AZ 85635; 1865 Baywood Lane, Sierra Vista, AZ 85635

My experiment involved the possibility of sewage being used as a resource to produce an inexpensive lactate solution that need not be purified. A lactate-sewage mixture may be used as a nutrient in sewage tolerant microbial processes, such as in the removal of oil from oil-shale.

Lactobacillus bacteria were isolated from sewage by placing sewage in milk, growing colonies on agar, then sliding and staining to identify under microscope. A series of inoculations of sewage-milk media was performed while reducing the concentration of milk. PH and HPLC test results were graphed, while using different samples of sewage treatments, to test for high lactate yield. Sludge was later tested qualitatively using a hydroxy-acid test. Aerobic versus anaerobic conditions were also compared for three organic acid concentrations and results were graphed.

Anaerobic conditions were favored for lactate production. Sludge was tested, after 48 hours of incubation, with the gastric juice color test. These results were inconclusive, but odor comparisons of the control and test solution suggested bacterial growth and lactate production.

This lactate-sewage mixture, if determined to be in high enough concentrations, may be used as a nutrient for *Desulfovibrio*, a bacteria strain used in the removal of oil from oilshale.

#REMOVAL OF HEAVY METAL CATIONS FROM INDUSTRIAL PROCESS WASTEWATERS USING INSOLUBLE STARCH XANTHATE

Walker, Kenneth B., Dickson County High School, Dickson, TN 37055; Route 3, Box 179A, Charlotte, TN 37036

Complexed copper removal is a major problem in industrial process wastewater treatment. A local printing company was faced with solving this problem. Insoluble starch xanthate (ISX) is a cereal grain based product that has been successfully used by some corporations to remove copper complexes from process wastewaters. Several tests were conducted to determine most favorable conditions for copper removal using ISX. Synthetic wastewater containing 1,000. mg/l copper was mixed. Samples were drawn from this stock solution. ISX alone was added to some, not appreciably changing ion content. Others were pH adjusted to alkalinity using NaOH. Filtration following this method was successful in reducing copper effluent to .15 mg/l.

Complexed copper could not be successfully removed, however, using this method. Several other methods were then tested, and a successful method was found. The successful method involved dual pH adjustment to high pH with re-acidification and ISX addition prior to second pH adjustment. With the use of ISX, complexed copper effluent was reduced to as low as .10 mg/l — well within legal output limits of .35 mg/l.

All methods were cost analyzed, and methods successful for complexed copper removal showed only slight cost increase (1.7¢/gal. to 2.3¢/gal.). Non-complexed copper was removed at an actual cost reduction (1.7¢/gal. to 1.0¢/gal.).

#First Award - Water Pollution Control Federation

THE EFFECTS OF HUNTING ON A DEER POPULATION: A SYSTEMS STUDY

Wilcox, Russell J., Masconomet Regional H.S., Topsfield, MA 01983
Georgetown Road, Boxford, Massachusetts 01921

The Crane's Beach Deer Reservation in Ipswich, Massachusetts is overcrowded. While the estimated carrying capacity is 50, the deer currently number 148. Fear of starvation during the winter led Rangers to organize a public hunt to thin the herd, but animal rights groups blocked it. The purpose of my project was to determine hunting's effect on deer population stability, and also to examine other wildlife management techniques.

My procedure had two parts. The first was to construct a computer model of the deer and their environment, using feedback systems simulation techniques. The second part was to subject my hypothetical deer to a series of different hunts. I also simulated feeding the deer and giving them chemical birth control.

My most important finding was that fall hunts in which a moderate amount (up to 30%) of the deer are killed can cut the standard deviation of the population by sixty percent, without lowering its average. After varying each hunt's season, I observed that hunts held in the spring have less stable populations and lower averages than hunts held in the fall. I also found that all-male hunts had more oscillation than those in which some fraction of females were shot.

I calculated that feeding the deer for one year would cost $8,500. If deer were fed as much as they desired for ten years, the total cost would be $2 million. This assumes, however, that the resulting herd of 10,000 would fit onto the 750 acre reservation. Finally, when I simulated the effects of birth control, the resulting population showed great stability, suggesting that further research in this area would be promising.

#First Award - United States Navy/Office of Naval Research
Third Award - General Motors ISEF

A FOUR YEAR ACID RAIN ANALYSIS THROUGH VARIOUS STUDIES

Cobb, Joyanne, Choctawhatchee High School, Ft Walton Bch, FL 32548
126 Jamestown Ave., Fort Walton Beach, FL 32548

This is my fourth year on the "Acid Rain Analysis Through Various Studies," that show the effects this problem has on our environment.

The studies which I have developed in the past three years, as well as keeping up with the pH levels in Okaloosa County through rain stations, are the Natural Environment Studies, Microscopic Life Studies, Aquatic Life Studies, and Seed Germination Studies.

These studies show the effects that various pH levels have on particular organisms. Each study has been further developed for this year and additions have been made on them. For example, to the microscopic studies, I have added a new organism, the Daphinia. To the aquatic life studies, I have added the blue-green algae, Anabaena. I have also added a totally new study all together, "The Aluminum Pollution Studies," which show the effects that aluminum reacting to acid rain have on the environment. These experiments are conducted with the use of guppies. Two new rain stations have been added, rain stations "B" and "C." Both of these are fresh water ponds and have aided much in the "Aluminum Studies" as well as acting as rain stations.

A SOLUTION TO POLLUTION: ENERGY FROM WASTE MATERIALS

Anderson, Geoffrey W., Oakville Trafalgar High School, Oakville, Ont. L6J 3L6;
395 Palmer Ave., Oakville, Ont. L6J 1T6.

Today's society is faced with many enigma, few of which surpass those of pollution and energy shortages in severity. Sewage sludge and solid wastes are the unavoidable byproduct of modern society. High disposal costs for these waste materials, coupled with a projected increase in waste production over the next decade, forms a serious problem. This experiment was aimed at contributing to a partial solution of the waste disposal and energy shortage enigma.

For this experiment, sewage sludge, wood (to represent solid waste materials) and a sludge/wood mixture were pyrolized in a batch reactor to produce oil. The production rates of oil were compared for the three materials. The oils were analyzed and general assumptions about their characteristics were drawn.

The average production rates of oil from all materials were excellent. The boiling range of the wood-derived oil proved to be slightly better than that of the sludge-derived oil, with the sludge/wood-derived oil being intermediate.

Sludge, waste wood (solid waste) and sludge/solid waste pyrolysis should be economically attractive as the feedstocks are both renewable and inexpensive. Plant attractiveness is greatly increased when the costs of alternate methods of waste disposal are taken into account. As such, sludge and solid waste pyrolysis should help alleviate the ever increasing pressure on traditional oil resources by providing an affordable alternative.

AN ANALYTICAL STUDY OF THE "WATERFUL" CHEMICALS WE DRINK

Picou, Susan, H.L.Bourgeois High School, Gray, LA. 70359
P.O.Box 32, Schriever, LA. 70395

My project is the result of diverse studies into different water types. All analytical work is based on the components of the following waters: bottled distilled, faucet, rain, and river. The studies, cation and anion analyses, range from basic reagent tests to precipitations and separations of groups of ions with similar qualities. Some of the questionable ions discovered were Cu^{+2}, PO_4^{-3}, and Cl^{-1}.

Numerous tests were performed centering around the bacterium found in the water samples. The bacterium were introduced onto various media including lactose broth, nutrient agar plates, nutrient agar slants, and Eosin Methylene Blue Agar. Of the utmost signifigance was the finding of the Escheria coli and the Enterbacter aerogenes, both quite harmful to humans. Dilutions were made for all tests in the following strengths: undiluted; 1:10; 1:100; and 1:1000. All research was conducted in a controlled laboratory environment to ensure safety as well as accurate results.

As part of my final conclusion, an extensive comparison between the four water types was performed. The charts, graphs and maps give an overview of my results and show the reasons for consern. The benefits of my project are two-fold; first, as a way of alerting public officals, in the area, to the obvious hazzards involving the various drinking waters and secondly as a means of involving the people of Terrebonne Parish into a deeper understanding of the "Waterful" Chemicals we drink.

EFFECT OF HERBICIDES & PESTICIDES ON RHIZOBIUM LEGUMINOSARUM

Ahle, Michelle O., New Ulm High School, New Ulm, MN 56073
520 N. Minn. (Box 192), New Ulm, MN 56073

The nitrogen-fixing bacteria Rhizobium leguminosarum was grown in a media of mannitol-nutrient broth tubes which contained a 0.1 % concentration of various herbicides and insecticides. These were then, after 24 hours of incubation, plated by the means of the pour plate method. One loopful of each mixture was added to a sterile Petri dish along with 20 ml. of sterile mannitol-nutrient agar. Total plate counts were made after 48 hours of incubation using a standard ruled bacteria colony counting plate. Two of the six herbicides had what appeared to be an adverse effect on the R. leguminosarum bacteria, which resulted in significantly lower plate counts than the control.

From the observations and data that was collected and observed, it was concluded that herbicides and insecticides do have an effect on the nitrogen-fixing bacteria R. leguminosarum. Further and more extensive research is needed for more conclusive data.

ACID RAIN: BUFFERING EFFECT OF HOCKLEY COUNTY SOILS

Richards, Wm. Mark, Levelland H.S., Levelland, TX 79336;
402 Poplar St., Levelland, TX 79336.

Spring rains gently bring the needed water to our agriculture. However, they are also carriers of destruction, for this is not normal rain but rain of high acid content. Along with the needed moisture, the rains bring the dangers of acid rain.

The purpose of my project is to test the buffering effect of Hockley County soils against the effects of acid rain.

The results of my project are decisive in that they show a definite buffering action against acid rain. In my testing I have found that the buffering action of Hockley County soils was sufficient to bring the ph from 3.0 to 6.9. My testing also shows that 6000ml of snythetic acid rain (ph 3.0) is needed to retard the buffering actions of the soils.

My project demonstrates that Hockley County soils are good buffers against acid rain, but that there is a point to the quantity of acid rain which can be buffered before the soil loses much of its buffering action.

#FACTORS IN PREDICTING WAITING PERIODS NECESSARY FOR SAFE CONSUMPTION OF MAJOR FOOD PRODUCING CROPS IN THE IMMEDIATE AREA OF A NUCLEAR BLAST

Carpenter, Julie A., Westerville North H.S., Westerville, OH 43081
6509 Sunbury Rd., Westerville, Ohio, 43081

This experiment attempts to determine the extent of the waiting periods necessary to safely grow and consume crops, primarily wheat and corn, in areas similar to Europe and Ohio after the "surface burst" of a nuclear warhead. The components of the soil will be determined by "Instrumental-Method Neutron Activation Analysis" (INAA). Use of information regarding elemental half-lives, crop nutrient uptake, permissible radiation dosages to humans, and biological half-lives, etc. will aid in predicting a probable time period before the resumption of farming. This experiment assumes a "limited nuclear exchange" which would not drastically change the environment, i.e., initiate a "nuclear Winter". Current results cannot be used as conclusive evidence. Further irradiations, analysis, and calculations should provide results for longer half-life isotopes. Questions for future studies are: (1) What would be the outcome of the information received from this experiment? (e.g., growing the plants in irradiated soil); and (2) What is the extent of the uptake of uranium and plutonium and their fission products

#First Award - United States Air Force
Second Award - Sigma Xi, the Scientific Research Society

NUTRIENT LEACHING RESPONSES TO ACID PRECIPITATION ON A FOREST ECOSYSTEM

Cooper, Jennett L., Cumberland Co. H.S., Crossville, TN 38555; Route 2 Box 416, Monterey, TN 38574

Concentrations of pH, acidity, Ca, K, Mg, and Na were measured from bulk rain samples taken from an open field, an open field with fog interceptor, and in throughfall and stemflow under conifer (Pinus virginiana) and deciduous (Carya ovata) canopy in Cumberland County, TN. All samples except the deciduous samples were nearly 100 times more acidic than the "normal" rainfall pH value of 5.7. Total nutrients added to the forest floor by throughfall and stemflow under the deciduous canopy was 1.7 and 1.4 times; conifer canopy was 0.6 and 1.0 times respectively, greater than that added in the open field.

ACID RAIN--"MANMADE PLAGUE"

Jones, Sonya A., Batesburg-Leesville H. S., Batesburg, SC 29006; Route 3, Box 84, Batesburg, SC 29006

Acid rain is one of the most serious problems facing the world today. I made a study to find out how acidic the rainfall is in different areas, what it can do to our environment, and what is being done about it.

Rain water was collected around my home for three years, tested for its acidity or "pH level," and then compared with the pH levels of precipitation in other areas of South Carolina and of the United States.

To test acid rain on animal and plant life, simulated acid rain of five different pH levels was made by adding sulfuric acid to tap water until the desired pH was reached--3, 4, 5, 6, and 7. Earthworms, seeds and plants were then treated at designated intervals over a period of time with this acidic water. After periodic "showers," tests then showed that earthworms could not live in pH 3 and 4 levels of acid rain, and seeds and plants receiving the lower pH's of water did not germinate or grow as fast.

From my search of scientific literature, I found that more monitoring stations are being set up statewide, nationally, and globally. Also, more money is being spent on research to learn how to reduce the acid rain problem.

COMPARATIVE AND ECOLOGICAL STUDY OF THE EFFECT OF CARBON MONOXIDE ON PHASEOLUS VULGARIS AND LYCOPERSICUM ESCULENTUS

Pérez, Daniel, Dr. Efraín Pérez Hidalgo High School, Moca, P.R. 00716; Urb. Las Palmas C-8, Moca, P. R. 00716.

The purpose of my investigation is to determine how carbon monoxide affects the plants Phaseolus vulgaris and Lycopersicum esculentus. The effect will be determined on the basis of how the gas affects growing, the amount of nodes on the plant, the amount of leaves and the amount of fruits. An attempt has been made to compae the effect on the cells of the leaves between the control and experimental plants. The environmental parameters were checked to see if they have an effect on the growing and reproduction of the plants and fruits. This was followed a comparison of the effect produced by CO on both plants and fruits. An attempt was made to obtain the real weight, the dry weight and the volume of their fruits for comparison with those obtained after exposure to CO. Maximum and minimum air temperatures of the air, relative humidity and surface were compared. The Lewis structure was used to obtain the relations and connections to carbon monoxide.

ACID RAIN'S EFFECTS ON PLANTS

Markway, Jeff, Blair Oaks H.S., Jefferson City, MO 65101
Route 6, Jefferson City, MO 65101

Although the area that I live in (Central Missouri) is not affected by acid rain, the State of Missouri is a high producer of sulfur dioxide, the cause of acid rain. I chose to show the effect of acid rain on plants because the problem could be studied under controlled conditions and the plants used are common to all areas. Three types of seeds were planted in trays filled with garden loam (pH 6.5). Corn (Zea mays), beans (Phaseolus vulgaris) and peas (Pisum sativium). One tray was used for each pH level. Twenty (20) specimens of each plant were planted in each tray, i.e., sixty (60) plants total in each tray. Concentrated sulfuric acid was diluted with distilled water to obtain pH levels of 5.5, 5.0, 4.5 and 4.0. Tap water pH was 7.5. The pH of the diluted sulfuric acid and of tap water was measured utilizing Phenaaphazine paper (range 4.0 to 7.5). Plants were watered every two days with 350 ml of either tap water or diluted sulfuric acid with the above pH levels and were sprayed with a bulb atomizer every day. Growth of the plants was measured every two days for a period of sixteen (16) days. Data collected was the average of plants of each type, in each tray. The decrease in growth from tap water at pH 7.5 versus the most acidic, pH 4.0, diluted sulfuric acid was, for beans, 77.8%; for corn, 70%; and for peas, an 81.8% decrease in growth. In the coming year, I plan to expand this project to include the effects of acid rain on leaf size, coloration and scarring.

#ADAPTATION OF CYCLOPOIDS TO VARIED SALT LEVELS

Schmidt, Christine E., L.B. Johnson H.S., Austin, TX 78724
3309 Pecan Springs Road, Austin, TX 78723

An experiment was performed to find out how rapidly a population of Cyclopoid copepods could adapt to toxic levels of sodium chloride. The sodium chloride is representative of environmental stresses that copepods are exposed to in their ordinary surroundings.

Small plastic cups connected with nylon strings allowed experimental copepods to migrate into adjacent containers with variable concentrations of salt solution. The concentrations ranged from the LD-50 of the population to a solution which produces 0% death. Simulating conditions in the natural environment, the cyclopoids freely migrated, became isolated and reproduced.

I collected copepods from a pond in Zilker Park, cultured them to build up the population size, and separated and tested them to make sure I had only one species to work with. I also determined the sodium chloride LD-50 level (the toxication that produces 50% mortality) of that species. Part of the population was kept as a control group.

After three months, the experimental cyclopoids showed an increased tolerance to higher salinity levels than the control group, due to a change in the genotype.

#Second Award - General Motors ISEF

MATHEMATICS AND COMPUTERS

THE TRISECTION DILEMMA

Uppal, Bobby., Eisenhower High School., Houston, Texas 77088
6531 Inwood West Dr., Houston, TX. 77088

PURPOSE:
The purpose in this project is to formulate an original, relatively simple, procedure for trisecting an angle, with the inherent error not to exceed 2 degrees for any portion of the trisected angle.

PROCEDURE:
The actual procedure developed for approximately trisecting an angle involves twelve steps. In general it is based upon using the measurements of a right angle, placed within the given angle itself, to trisect the given angle's arc.

RESULTS:
The original method of approximately trisecting an angle devised yields an error not exceeding 30 seconds (1/2 degree). In addition, unlike other approximations, the inherent error in this method is constant regardless of whether the angle is acute or obtuse.

CONCLUSIONS:
Although trisecting an angle with only straightedge and compass is impossible, the procedure developed is an efficient way of approximately trisecting an angle and yields an error less than that of other methods comparable in simplicity.

#First Award - National Aeronautics and Space Administration

X-S3L: THE LANGUAGE EXTENDED

Hoggard, Barry G., Greene County Tech H.S., Paragould, AR 72450;
P.O. Box 161, Paragould, AR 72451

This project involves the two-year design and implementation of a computer language. The source form is compiled, or translated, to assembly language by a compiler constructed by me. The compiler consists of two programs which translate the source program into an intermediate language before a final translation to assembly language.

The language is known as S3L (Extended Structured Low-Level Language). As the name indicated, it is structured and lacks a 'goto' statement. The variables supported are integer and character types, with local or global scopes. All arithmetic operations are supported, as well as boolean and relational operators.

The language is designed for systems programming, such as compilers and interpreters. Its main applications will use it as an alternative to assembly language.

#First Award - Upsilon Pi Epsilon, the National Computer Science Honor Society

PARALLEL MICROPROCESSING

Bencze, William J., St. Francis H.S., Mt. View, CA 94040
19287 Brookview Dr., Saratoga, CA 95070

The objective of this project was to design, build and program a computer system, with parallel processing capibility, which could execute multiple programs simultaneously.

The approach consisted of the selection of a representative problem, the formulation of the basic computer architecture, the development and fabrication of the hardware, and the development and coding of the software. During the initial phases of development, the "Three Body Problem" (a classical physics problem) was chosen as the application/demonstration program for the system and it served as a guide for the basic architecture of the computer. The system was designed with three microprocessors; each microprocessor was dedicated to the computation of the positions and velocities of one of the three bodies. The architecture centered around a master/slave control heirarchy, with the master serving as the main channel of data exchange. The hardware contained the microprocessor support logic, input/output, and data exhcange circuitry. The software consisted of a system control monitor, floating point mathematics routines, binary to decimal conversion routines, and the three body application program. The entire system, both hardware and software, was of an original design, assembeled using approximatly 60 integrated circuits, and programmed in machine language. The total program occupies 15 kilobytes of memory.

The overall project was very successful; all aspects functioned properly, yielding realistic physical results. It was found that the use of parallel processing is an efficient approach to analyze problems with interacting processes.

#First Award - General Motors ISEF
Scholarship - United States Navy/Office of Naval Research
Second Award - United States Air Force
Honorable Mention - Association for Computing Machinery

C.A.P.P. II (Computerized Aid for Paralyzed People)

Brauneis, George W., Delta, CO 81416;
1146 A 60 Lane
Delta, CO 81416

Purpose: The Purpose of this project is to provide a person who is paralyzed and who also has speech impairments, the ability to carry on a standard conversation with the aid of a computer.
Procedure: There were many steps involved in the procedure including (1) Working with paralyzed people. (2) Analyzing there needs. (3) Developing different input units. (4) Writting a program that communicates. (5) Testing the program and input units. (6) Making improvements and correcting errors in the program and input units.
Conclusion: IT has been concluded that a person who is paralyzed and who also has speech impairments can communicate with the aid of a computer and with the use of a customized input unit.
References: (1) Hilltop Rehabilitation Center. (2) The Grand Junction Regional Center. (3) Personal Computers for the Physically Disabled: A Resource Guide. (4) Atari Reference Manual. (5) S.A.M. Owner's Manual.
Special Thanks To: (A) The Grand Junction Regional Center (1) Ron Addington (Director) (2) Jeannie Johnson (C.P. Victim) (B) Hilltop Rehabilitation Center (1) Ron Halsey (Directon, Quadrapalegic)

#Second Award - BDM Corporation
Third Award - General Motors ISEF
Honorable Mention - American Speech-Language-Hearing Association

LANPROC: A NATURAL LANGUAGE PROCESSOR

Fraley, Christopher Lee, Wilson Senior High, Reading, Pa. 19609
1753 York Road, Reading, PA 19610

The purpose of my project was to write a program that could, to a limited degree, understand natural English. To accomplish this task, the grammatical structure of English was studied, and a theory of how meaning is expressed in English was developed. After the research and theory were completed, a program was written in LISP to process English sentences.

LANPROC (natural LANguage PROCessor) is a natural language processing (NLP) system written on an 48K Apple II Plus. LANPROC was written in P-LISP, a version of LISP written by Gnosis Software for the Apple. This program is a "core" to a NLP system, allowing new words to be added to its vocabulary with only a minimal amount of new code. This is because LANPROC is designed to understand the grammar of English, instead of the grammar for a specific set of words.

The amount of memory available on the Apple limited my experiment to a relatively simple environment. This environment consists of a low-resolution color graphics screen and a text screen. LANPROC allows a user to ask the computer questions or give commands related to these screens in natural English.

In addition to writing LANPROC, a full-screen text editor was written to edit P-LISP programs. This editor was written in 6502 machine language with a BASIC subroutine to handle disk access.

#First Award - Association for Computing Machinery
Fourth Award - General Motors ISEF

#NAME: Galarus, Douglas
HOME ADDRESS: 3117 Eldora Lane, Missoula, MT 59803
SCHOOL: Sentinel High School
SPONSOR/TEACHER: Jim Cusker
TITLE: The Determination of a Heuristic Algorithm to "Solve" the Traveling Salesman Problem in Low-Order Polynomial Time.

There exists a certain group of mathematical problems for which there are no known methods to provide solutions within a reasonable amount of time despite the use of high speed computers. One such problem is commonly known as the "Traveling Salesman" Problem. Given a set of cities and a corresponding distance matrix, the desired solution consists of a tour of all cities which has a minimal total distance. For a set of N cities, the are N! possible tours. Therefore, it can be seen that it would be virtually impossible to compare all routes in search of the shortest. For this reason, a study of the problem was conducted and resulted in the derivation of a Heuristic/Approximation Algorithm which provides an adequate solution within a reasonable amount of time.

#Second Award - IEEE Computer Society
Fourth Award - General Motors ISEF
Honorable Mention - United States Air Force

#SYNTHETIC DEVELOPMENT OF CONCEPTUAL HIGH-LEVEL DIMENSION SYSTEMS

Jordan, Craig R., Putnam City North H.S., Oklahoma City, Ok. 73132; 6609 Crow Circle, Oklahoma City, Ok 73132.

To model many dimensions conceptually is impossible if exact physical representation is necessary. However, if distorted, but topologically equivalent systems are used, then any number of dimensions can be modeled conceptually. The purpose of this project is to develop a mathematical characterization of distorted copies of the right-angle dimension system. Such systems are based on an angle other than 90 degrees and -- in general -- have more conceptual dimensions available.

The technical development of the project includes several definitions and theorems. The definitions are necessary simply to discuss the project effectively. The theorems develop important charactistics of the distorted dimension systems.

The majority of the development deals with what are called "dimension bases" or "cubes". The most important characteristic of a right-angled i-cube is that it can be closest packed with itself to fill all i-space, creating an i-dimensional matrix such that every vertex is connected to exactly 2i other vertices by unit-length edges. Once distorted the major characteristics of the i-cube are retained. A distorted i-cube can be characterized as a polygonal or polyhedral pattern that can be uniformly overlapped to fill all distorted i-space creating a distorted i-dimensional matrix where every vertex is connected to exactly 2i other vertices by unit-length edges. From this description many important theorems can be developed.

The eventual purpose of such a mathematical characterization is the interpretation of high-level equations graphed in distorted dimension system.

#Fourth Award - General Motors ISEF

SHAWN SHEALY'S PRACTICAL PRINT SPOOLER!

Shealy, Shawn, Lexington High School, Lexington, SC 29072
125 Stoney Brook Lane, Lexington, South Carolina 29072

Many microcomputers have a deficiency when it comes to printing. The problem is this: when the computer wants text to be printed on a printer, it sends the text character-by-character to the printer waiting for the printer to finish printing before the computer continues. For my project, I designed a machine language program that moves text to memory and then spools the text out as the printer can accept it, while continuing with other processing. When the text is waiting in the computer, the computer will test every twenty milliseconds by using a timed interrupt to see if the printer is signaling that it is ready to receive more text. The memory buffer in which the text is initially stored is variable, inasmuch as its size can be changed by the operator when the spooler is initiated. The program is totally independent of a disk operating system, thus allowing a great amount of compatability. With minor changes, it can be executed on practically any Z-80 based computer. The spooler automatically protects itself in high memory. The result is that the spooler increases efficiency of any basic program which sends text to the printer.

#FIBONACCI SERIES FOUND IN GROWTH PATTERNS OF NATURE (MICROCOMPUTER SIMULATION MODEL DEVELOPMENT)

Eda, Katherine Emiko, Secaucus High School, Secaucus, NJ 07094
4 Allan Terrace, Secaucus, NJ 07094

Nature may appear to be growing with immense variety and randomness. After careful observation, however, scientists and mathematicians can reveal growth patterns which are restricted to a few formal themes. The objective of this project was to study the growth patterns in nature with the application of the Fibonacci Series. (1) Basic mathematical models with the utilization of Fibonacci numbers in the increase of branches and phyllotaxis have been developed. With the addition of phototropism, geotropism, thickness of the branches, and the Monte Carlo method, suprisingly lifelike forms of trees have been simulated on a microcomputer. (2) Ideal angle of phyllotaxis has been established as being 222.48° or 137.52° (obtained by dividing 360 by the Fibonacci ratio) and numerically proven on a microcomputer as having the least amount of overlapped area and optimal efficiency as a biologically growing system. (3) Preliminary experiments of producing the Fibonacci sequence showed the computer would print out numbers with less than ten digits before resorting to exponential notation. A program was written to correct this, and substantially large numbers of the Fibonacci series with over 1040 digits have been fully printed out.

Thus successful analysis of biological processes in their mathematical and physical aspects has been preformed, and it has been proved that dynamic growth systems can be simulated very well on a microcomputer by utilizing a few major themes. This opens opportunities for manifold uses, including similar mathematical model applications in the research of botany and biology.

#First Award - American Medical Association
First Award - Sigma Xi, the Scientific Research Society
Third Award - General Motors ISEF

THE SIMPLEX METHOD

Cachon, Gerard, Ketcham H.S., Wapp. Falls, NY 12590;
14 Helen Dr., Wappingers Falls, NY, 12590

It is often necessary to complete a task in which restrictions have been imposed on you. These restrictions may include limited labour, resources, transportation or money. These restrictions often make it impossible to choose the correct course of actions that will give the greatest return.

It is through the simplex method that someone can determine this path. The simplex method is an algorythm that solves an algebraic interpretation of a given situation to eventually arrive at the optimal solution.

Like most algorythms, there are many variations to it. These variations include different approaches to solving the problem and different methods of setting up the problem. It was my goal to analyse these variations in order to determine which variation is most practical for small computer implementation.

COMBINATORIAL THEORY: A MAP-FOLDING PROBLEM

Davenport, W. Jeptha, Macomb Senior High School, Macomb, IL 61455
603 S. Lafayette St., Macomb, IL 61455

The purpose of this project has been to construct an algorithmic solution which yields the resulting number of all possible differing fold-combinations of a piece of paper, or map, given the number and directions of its predetermined creases.

The researcher used the theories of combinatorial mathematics in order to produce the algorithmic process described above.

An algorithm which may solve for the total number of folding combinations of all conventional maps has been developed. Several numerical wedges, similar in form to Pascal's triangle, were created as part of an algorithmic process, along with several original, special series of numbers, all of which combine to find the various solutions to this original problem.

LOGIC - MATHEMATICAL STUDY OF THE TETRADIMENSIONAL ABSTRACT FIGURES

Rolón-Morales, Iván, Lino Padrón Rivera H.S., Vega Baja, PR 00764
Bo. Algarrobo, Carr. 2, Km. 42.2, Box 745, Vega Baja, PR 00764

It's possible to know properties of four-dimensional figures based on law patterns that describe figures of three or less dimensions. It also deals with a series of basic principles (postulates) and theorems that establish the elaborations of other postulates and theorems for the space in the fourth dimension. Beside these figures, one studies tetradimensional space with particular attention on possible perpendiculars and the introduction to geometric directions. Not only will these studies be applied to a completely abstract four-dimension but many of the mathematical laws can be applied to the figures of three dimensions or less than three.

This research does not affirm the existence of a fourth-dimension nor does it relate to the Relativity Theory of all, though it doesn't discard the possibility of being applied to the said theory.

THE CHEMISTRY PROGRAM

Fudge, Gary A., Oxford High School, Oxford, MS 38655
1517 University Avenue, Oxford, MS 38655

The Chemistry Program is a project that tries to determine if a microcomputer is capable of solving complex chemical equations and show chemical related activities with greater speed and efficiency than humans and still be relatively easy to use. I believed that this could be done so I created a completely modular program for the testing. A test was given to high school chemistry students with computers and students without computers. The students with the computers did 31 percent better and completed the test faster than the students without the computers, therefore, a microcomputer can be used by high school chemistry students if an appropriate program is developed.

#Second Award - Patent and Trademark Office/ U.S. Department of Commerce/ Patent Office Society

COMPUTER SYNTHESIS: SPEECH AND MUSIC

Worrall, Brian M., Honey Creek J.H.S., Terre Haute, IN 47802;
1116 Greenleaf Court, Terre Haute, IN 47802.

Computer-generated sound is fairly new, yet it already has many applications. It adds another dimension to music. It creates speech, which can be used by the handicapped as well as educators. Computer synthesis will play a major part in the future of mankind.

While the software for sound synthesis may vary, the process of sound output is the same in most computers. Instructions are stored in the memory of the central processing unit (CPU) as binary code. In the TRS-80 Color Computer, this data is sent to the peripheral interface adapter (PIA), address $FF20. This controls all computer output. The data is routed to the digital-to-analog converter (DAC) and changed into a voltage (-5V to +5V). These charges are put through the analog switch and played through a speaker.

The principles of sound generation are the same, too. Sound waves and attack-decay-sustain-release (ADSR) envelopes are used to produce sound. Since each sound has its own envelope, the computer reproduces an envelope, thus creating a particular sound.

Voice synthesis goes a step beyond sound synthesis, because phonemes, the building blocks of speech, must be individually synthesized. An easier technique, digital speech, is computer-recorded speech played back from memory.

I started the project last summer with a 16K Color Computer, and through time and effort it has progressed into a 64K computer project. The 64K capabilities enhance the demonstration by adding speed and graphics to the original programs.

3-D UTILITY

Rahall, George G., Fayetteville High School, Fayetteville,WV 25840
115 Maple Ave., Fayetteville, WV 25840

PURPOSE/APPLICATION: To show how three-dimensional graphics and microcomputers are used in industry today. To find a way for the average person to control a computerized drafting board without being a mathematical wizard.

HYPOTHESIS: Variable resistors will be used as sensors to communicate with computers so that coordinate entry is made fast and easy. Programs will be designed that send +5 volts to the resistor and read how much voltage is returned. From here the computer may plot points which are controlled by hand held 3-D Utility. Now diagrams may be designed on the terminal and tested for efficiency before production money is spent.

PROCEDURE: Assemble a 3-D Utility which consists of variable resistors hooked into the input/output port of an Apple II computer.
Send a positive 5 volts to each of the potentiometers.
Read x, y, and z coordinates by taking a reading from the variable resistors (potentiometers).
Use coordinates to simulate 3 dimensional diagrams onto the computer's 2 dimensional screen.
Manipulate x, y, and z in appropriate equations to obtain viewpoints from all angles.

CONCLUSION: The 3-D Utility was successful in entering accurate coordinates easily. Likewise, the programs which incorporated the use of the 3-D Utility proved to be cost efficient and very easy to use. Now, the programs and the 3-D Utility may be used to design diagrams, blueprints, schematics, etcetera. But now, not only may you see these blueprints from the front, you may see them from the sides, also.

#A 2-YEAR STUDY OF A MEANS OF COMPUTERIZED DIFFERENTIAL IDENTIFICATION THROUGH DENTAL CONFIGURATIONS

Ames, Sheryl L., Fort Lauderdale Christian School, Fort Lauderdale, FL 33309;
7300 N.W. 10 Place, Plantation, FL 33313.

The purpose of this project is three-fold. First, the development of an inexpensive and reproducible method of recording an individual's dental bite marks on a medium suitable for transferring the location of the bite marks onto a standard millimeter grid. Second, the development of a computer program written in the BASIC language that would convert the bite marks from the standard grid coordinates to numerical values. Third, the development of a computer program which will utilize the bite mark information to differentiate between individuals.

Six models for bite registration were tested and the last one, the carbon paper bite wafer was used to obtain the bite registrations of the test subjects.

The numerical coordinates of each bite registration was transferred to the computer and a program was written to build files of bite mark records and to update those records. The program was then expanded to read the files, print the files and retrieve information on any test subject, with options for screen-reading or hard copy. In addition, the program was expanded further to receive an unknown set of bite mark records and compare them with those stored in the computer. In this manner, the computer could be used to identify an individual who would otherwise be unidentifiable.

The computer program was tested and the hypothesis of the study was proven. The speed and accuracy of the computer, coupled with this program makes the use of bite mark data uniquely valuable in the identification of individuals.

#First Award - Online Computer Library Center
First Award - Patent and Trademark Office/ U.S. Department of Commerce/ Patent Office Society
Third Award - General Motors ISEF

#ASSEMBLY MANIPULATION OF THE 6502 AND INTERFACE TECHNIQUES

Welch, Scot D., St. Martin H.S., Ocean Springs, MS 39564; 12501 Hanover Drive, Ocean Springs, MS 39564.

My project deals with an indepth analysis of applied Assembly language programming with a working model of an original arcade game and an interface project designed to take advantage of the program's ease of use. The arcade game is a culmination of 1 and a half years of programming and study of Assembly language. The program consists of approximately 4000 lines of Assembly code, the use of sound, the application of color and a study of its limitations, and an interface project. The purpose of my project was to challenge and apply my abilities and knowledge of computers and electronics in an actual working model. As a result of my studies, I have self-taught myself an extensive amount of programming techniques that involve fast and efficient code, sound theories, and the use of external devices to control program output. The program was written entirely in 6502 Assembly language and occupies approximately 32K of memory including the data and display used to control it. The program is of arcade quality; and therefore, it provides an excellent model of how and what makes the seemingly mystifying and addicting electronic arcade games work. In a further attempt to simplify some of the processes involved in my project, I have written a detailed report that provides an explanation of what each Assembly code instruction does, and a schematic of the interface project involved.

#Fourth Award - General Motors ISEF
Honorable Mention - Association for Computing Machinery

#A STUDY IN PARALLAX WITH APPLICATIONS IN 3-D COMPUTER IMAGERY

Seymour, Jonathan C., Vanguard H.S., Ocala, FL 32670
2216 NE 7th Street, Ocala, FL 32670

The ultimate goal of my project was to calculate and display on a computer monitor the distinct, different images of an object as seen by each eye, given information about the size, shape and location in space of the object. The images would then be directed to the proper eyes, and the illusion of depth would be created—the image would appear three-dimensional.

I felt that the key to this technique lay in parallax. Using plexiglass sheets as planes of reference, I performed human and extremely accurate laser experiments dealing with the shift of an object due to parallax. Through this experimentation and geometric analysis, I was able to formulate two equations—one, a general parallax formula, and the other, a specific formula designed to give coordinate values pertinent to the programming aspect of the project.

The program is a relatively straightforward application of the latter equation. Given the required information about an object, it calculates or asks for the locations of key points on that object (the corners). The values for these points are plugged into the equation, which yields numbers that are converted to pixel coordinates and plotted. Lines join the points—red for one image, green for the other. With a pair of special green and red filtering glasses, the images are directed to the correct eyes. The brain then interprets the visual information as a three-dimensional object.

#Honorable Mention - American Optometric Association and Auxiliary to the American Optometric Association

MEXL: A MODULARIZED EFFICIENT GRAPHICS LANGUAGE

Bigbee, Anthony J., Stanton College Preparatory School, Jacksonville FL 32209
4286 Baltic Street, Jacksonville, FL 32210

Heretofore, a high-speed three-dimensional graphics language has been unavailable for most microcomputers. Minicomputers, mainframe computers, and supercomputers, with their vastly greater memory capacities and execution speeds, have utilized such a language for some time. Although microcomputers have limited memory, by programming in assembly code--the computer's "natural" language--an efficient three-dimensional graphics language can be designed.

In a 19-month undertaking, MEXL (Modularized Efficient Graphics Language) was written, debugged, and tested, specifically for the TRS-80 Color Computer. Features include optional perspective or non-perspective viewing and magnification. A MEXL User's Guide and MEXL Technical Reference Manual accompany the work, as well as numerous documentation photographs of MEXL's 3-D graphics projections.

When MEXL's command execution sppeds were tested and compared with their BASIC counterparts, MEXL projected images, on an average, 56 times faster. Still and timed-exposure photographic analyses revealed striking, high-quality 3-D graphics.

MEXL's applications are numerous, and include possible aiding in architectural visualization of buildings and dwellings, aeronautical engineering in projecting conceptual and proposed models, in education and art fields, as both a concept demonstrator and as an unending source of computer-generated three-dimensional graphics.

MEXL was copyrighted in 1984. Future plans include further code optimization and increased degree of magnification, with marketing of end product to a software retailer or distributor.

THE FOURTH DIMENSION

Flynn, Gabriel J., Jamestown Senior High School, Jamestown, N.D. 58401
520 First Ave. North, Jamestown, North Dakota 58401

We live in a space of three dimensions; that is we have three perpendicular types of movement. We call these three dimensions length, width, and height. We know what a space of one, two or three dimensions looks like. Is it possible to have a space with four dimensions, a fourth dimension perpendicular to the three that we have now?

My project is on the fourth dimension and the curvature of space. I investigated many properties of the 4-D hypersphere and the hypercube. I found that the use of analogy was the best aid in understanding the fourth dimension and curved space. I imagined how a 2-D creature (A. Square) living in a 2-D world (Flatland) would go about studying the third dimension. This made it much easier for me to do my project.

In my project I have included papers on the fourth dimension (Flatland, Lineland, and methods for finding the 4-D hypersphere and hypercube), and curved space (Euclid's first and fifth postulates, curved Flatland and Lineland, and expanding universe).

AIRFOIL PLOTTING

Carlton, Guy J., Evanston High, Evanston, Wyo. 82930;
748 Lombard, Evanston, Wyo. 82930.

An Airfoil is a shape or a body designed to get a certain reaction from the air flowing around it. This reaction is called lift, or the upwards force on an object.

Airfoil plotting is based on the properties and reactions of different airfoils. This is done by entering descriptive points of the airfoil into the computer. The computer will then calculate all of the points along the outline of the shape and check for errors. The length of the upper and lower cambers, the chord length, the pressure of the ambient air and the speed at which the foil is traveling is entered into the computer. This information is used to calculate a difference in pressure on the top and the bottom of the foil. If the pressure on the bottom is greater than that of the top, a lifting force is formed by the inequality.

With this information one can decide if the shape has lift capabilities and determine what other reactions the shape will invoke. This could speed up the trial and error testing of airfoils in wind tunnels. Not having to test each airfoil for its reactions accelerates the design process and the ultimate quality of the airfoil.

Although the program is not able to tell the finer details of airfoils and their reactions, it can give a fairly good idea of what can be expected.

THE PHYSICS SURVIVAL GAME

Jackson, Michael Todd, Batesville H.S., Batesville, AR 72501
Route 3, Box 156 B, Batesville, AR 72501

No abstract received.

#COLLISION - ANNIHILATION THEORY: A MATHEMATICAL MODEL FOR T=0 AND THE EVOLVING UNIVERSE.

Moody, Camille, Keystone School, San Antonio, TX 78212;
11902 Mesquite Mesa, San Antonio, TX 78249

The question of "What made the Universe?" has been partially answered with the Big Bang theory, leaving the question of "What made the Big Bang?" yet to be answered. In an attempt to solve this problem, I have proposed a model for the origin of the Universe based on the emergence of electromagnetic waves from the fluctuating vacuum of space. A collision between two such highly energetic waves could produce a real particle pair. The subsequent annihilation of this pair in a matter-antimatter explosion is the detonation of the Big Bang at t=0.

As the Universe evolves, it attains some interesting properties which may be linked with simple mathematical patterns of nature. For example, since the Universe is simultaneously spinning and expanding, a given portion of the Universe will appear to trace a spiral path. The angle associated with this spin-expansion component is complementary to the point angle of a pentagram, and therefore could be related to the Golden Ratio, a ratio hidden in many natural structures. More importantly, though, the combined directional-expansional component could cause sections of the Universe to travel at supra-light speed, thus breaking the barrier of the fourth dimension. This clue to extra dimensions is in accordance with a new Grand Unified Theory proposal which explains different Universe forces as a single force of different dimensions. Additionally, another basic pattern was discovered in which volume ratios among N-dimensional spheres produced the increasing infinite series, 2/3, 3/4, 4/5, ..., thus showing the simple continuum among the dimensions of the Universe.

#Third Award - General Motors ISEF

Alternate to Scholarship - Ohio State University

#AN EXPERIMENT IN ROBOT INTELLIGENCE

Yegerlehner, James D., Perry Meridian H.S., Indianapolis, IN 46217
8204 S. Delaware St., Indianapolis, IN 46227

The purpose of this project is to determine a machine's learning capability.

Three algorithms in the form of computer programs run on the robot's controlling computer were compared. These algorithms have been arbitrarily named Alpha, Beta, and Gamma. The Alpha algorithm bases its responses to its environment on random behavior. Beta remembers responses that were successful in a given situation and uses them later in that same situation. Gamma is similar to Beta, but is also capable of using a response in situations similar to the one in which the response was learned.

To test these algorithms, the robot was programmed with one of the three algorithms and placed in a small rectangular test environment. It was allowed to move within this environment until it made thirty contacts with obstacles. If its response carried the robot back into the obstacle, it was counted as an unsuccessful response. If the response carried the robot away from the obstacle, it was counted as a successful response. A record was made of the robot's responses, with a number of trial runs being made for each algorithm.

A graph of the percent of responses correct vs. the number of tries (responses) was made from the compiled data of the test runs. Alpha's percent correct did not rise as it made repeated attempts, revealing that it did not learn. Both Beta's and Gamma's graph lines rose significantly, showing that they did learn from past experience.

#Fourth Award - General Motors ISEF

#DISCOVERY OF A GENERAL SOLUTION TO A LINEAR DIOPHANTINE EQUATION

Folse, Rachelle F., E.D. White Catholic H.S., Thibodaux, LA 70301
Route 2, Box 3, Napoleonville, LA 70390

The objective of this project was to find a general solution to a Linear Diophantine Equation (LDE), an equation of the form $A_1X_1 + A_2X_2 + A_3X_3 + \ldots + A_nX_n = C$, given an initial solution. In previous research I investigated methods of determining initial solutions to these equations, but I could not find a general solution, given an initial solution, when the number of unknowns was greater than or equal to 3. After consulting with experts in the field of mathematics from various universities, I was told that this was a topic with a substantial amount of original expository work to be done. I was successful in my efforts to develop a method for finding this general solution.

First, one must find an initial solution using known methods. The second step involves obtaining a general solution to the Homogeneous Linear Diophantine Equation which is the original LDE set equal to zero. A method of transforming this equation, the result being an equation with a unit coefficient, was developed. The third step involves the addition of the results of steps one and two to obtain a general solution. The development and proof of a theorem explaining why this procedure may be performed was presented.

In conclusion, important military and civilian applications using these new discoveries were investigated. One example of a relevant application of these discoveries would be the employment of LDE's with a general solution in the encipherment of important secret military information.

#First Award - National Aeronautics and Space Administration
First Award - United States Air Force
Operation Cherry Blossom - United States Army

PALINDROMIC NUMBER THEORY

Swallow, John R., Hartsville H.S., Hartsville, SC 29550;
316 W. College Ave., Hartsville, SC 29550.

Due to an interest in mathematical theorems that had not yet proven or disproven, the analysis of palindromes by addition (using the Add Reversed Digits process) was begun. Computer programs and formulas were developed for the prediction of reverse-palindromic numbers (numbers that, after being subjected to the ARD process for a certain number of steps, yield a palindrome). The ARD process was studied backwards to achieve formulas that detail the digit composition of reverse-palindromic numbers. Computer programs were used for mass collection of data on various numbers in bases two through ten.

Base four was proven false to the conjecture that all numbers in base four would become palindromes when subjected to the ARD process. It was inadvertent and occurred due to a pattern in one of the base four numbers. All other bases except base two, which had been disproven by Alfred Brousseau, were neither proven nor disproven due to underdeveloped formulas. The reverse-palindromic formulas represent the major part of this work, and though they detail significant relationships between successive steps of the ARD process, they are not enough to present a proof or disproof of the conjecture that for each base, all numbers eventually become palindromes when subjected to the ARD process repeatedly.

#Third Award - General Motors ISEF
Third Award - Mathematical Association of America

ON TRIMMING A TRIANGLE

Yu, Jiu-kang, Taiwan Provincial Tainan First High School, Taiwan, 700
142, Tung Ning Rd., Tainan, Taiwan, Republic of China

From one triangle, we can form another smaller triangle by fixing two vertices and moving the third along either edge toward one of the fixed vertices. We call it a basic trim. Goodman conjectured that any smaller triangle formed from the original in n trims could be obtained in less than 7 trims.

In terms of barycentric coordinate, a basic trim can be represented by a 3 x 3 matrix $M_{pq}(s)$, from identity matrix $I = (\delta_{ij})$ by replacing δ_{pp} by s, δ_{pq} by 1-s, where $p \neq q$, $0 < s < 1$. For example $M_{12}(s) = \begin{bmatrix} s & 1-s & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ represents the trim of $\triangle ABC$ by moving A along $\overline{AB}$ of length $(1-s)\overline{AB}$. The result of two successive trims is represented by the product of two representing matrices, and vise versa.

Chu and Huang (Chinese Journal of Math., 8(2), 1980) proved that any product of M_{pq}'s is a product of six such M_{pq}'s times I, $I\delta$ or $(I\delta)^2$, where $I\delta = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{bmatrix}$ amounts to a relabeling of the vertices of a triangle.

If relabeling is not permitted, we show that Chu-Huang's algorithm failed in 5 cases. We reconstruct an algorithm with computer program, and show that if the conjecture is true then our algorithm works for all cases. We tend to believe the conjecture is true for we have successfully run our program over all possible product of 7 M_{pq}'s with an increment of s=1/12.

We believe that a computer algorithm approach may lead to the higher dimensional generalization. Since our matrices form some kind of Markov chain, our algorithm might be of practical value.

#Fourth Award - General Motors ISEF
Honorable Mention - National Aeronautics and Space Administration

#TPP: A DISK PROTECTION - DATA ENCRYPTION SCHEME

Stryjewski, Peter J., Central High School
Davenport, IA 52803
2626 Ridgewood Ave., Davenport, IA 52803

The purpose of my research is to develop a protection scheme that can protect against all current methods of "deprotection". To accomplish this the scheme will be composed of three modules. The three modules currently in operation are the read-write translation table, the data encryption portion and the copy protection scheme. All of these modules are employed on any disk that is protected with this system.

The copy protection subsystem makes use of two systems to write data to the disk. The first system makes use of an algorithm that varies the length of string of data being written to the disk. The second is a spacing technique that varies the space between the data on one track. This subsystem has been tested and has protected against several of the "state of the art" copy programs.

The data encryption portion is working and is functioning properly. This subsystem will take any piece of data and convert it to another piece of data and write the data to the disk. Then the subsystem helps to prevent against copy programs.

This protection scheme can protect floppy disks for the Apple II+ and the Apple IIe. This protection scheme is currently protecting three disks. The disks have been tested and no way has been found to access the data or copy the programs.

#Alternate to Scholarship - Ohio State University

COMPUTER-AIDED ANALYSIS OF INHERITED EQUINE COLOR GENETIC PATTERNS

Brown, James A., Abingdon H.S., Abingdon, VA 24210
1051 Clark St., Abingdon, VA 24210

This project involved the development of a computer program capable of analyzing basic equine color characteristics from a genetic standpoint. This program can be used to determine the possible phenotypes occuring after a series of crossings between different animals with defined phenotypic and/or genotypic characteristics. Furthermore, this porgram is capable of resolving questions of true parentage in some cases.

A simple example of the use of this porgram is when a liver bay colored foal is born out of a liver colored mare. Given that of the two stallions that had access to the mare, one has both a liver colored sire and dam, whereas the other has chestnut shaded parents, it can be proven that only the stallion having chestnut shaded parents could have produced the foal in question.

Although the portions of this project dealing with genetics are thorough and accurate, the emphasis of this project is placed upon the application of computer science. Sound programming theories and practices were applied. Specialized routines to handle genetic information were developed to treat the genetic data as multi-dimensional arrays stored in linked lists. Natural examples of both recursion and dynamic variable allocation are used, and a strong user interface built around multi-level pop-up windows and a pointing device is provided. It is the belief of this programmer that a user-friendly interface should be an integral part of any serious program.

PASCAL KEYBOARD MONITOR EMULATOR

Lyle A. Boroski, New Mexico Military Institute, College & Main,
Roswell, NM 88201
P.O. Box 1084, Tularosa, NM 88352

The Pascal Keyboard Monitor Emulator's main purpose is to provide an environment to run Pascal programs while simulating a keyboard monitor. It was designed to be a very user friendly program. The commands are simple and concise. Most of the commands resemble the commands of the Basic Plus Keyboard Monitor. This is for consistency and user ease.

The Emulator will find, compile, link, and run the user's program. If the user's program is error checked before it is run, then a list file is built with compilation statistics and diagnostics. The user may proceed to list the statistical file. If the statistical list file is not found, then the Emulator lists the source Pascal program. The user can have his account number put into a separate file. This will enable the Emulator to erase all files before deleting the files.

The Emulator has several user convenience options. The current account number, job number, time, and date can be seen with the TIME option. Other information such as keyboard number, connect time in minutes, kilo core ticks, default run time system, user file directory clustersize, user account quota in blocks, number of blocks used, and number of free blocks available can be accessed by the ACCOUNT option. The CATALOG option gives the user a directory and statistics of all Pascal related programs on the specified disk drive.

The Emulator can be very easily accessed by a CCI (Concise Command Language) command. The command is "PASCAL". The Emulator has an extensive help text that explains the capabilities of the Emulator. The Emulator was developed and tested on a PDP 11/70 mini-computer.

SEQUENCES IN FIBONACCI NUMBERS AND COMBINATIONS

David Torres, Santa Fe H.S., Santa Fe NM 87501
Box 86EE Route 9, Santa Fe NM 87501

My purpose in this project is to study the characteristics of sequences of numbers by using fibonacci numbers as a model. Beginning with the various methods of counting, I studied how our number system has improved from Roman numerals to our present-day base-ten system of Arabic numerals.

I hoped to prove that sequences of numbers are not merely a jumbled mess of numbers, but that they do serve a purpose in our activities. I began with relating fibonacci numbers to the "golden section" and indirectly related this principle to other examples such as the Egyptian pyramids, the star pentagrams, the logarithmic spiral, and the cube root of a sphere. Then I extended my research by seeking a formula that could be derived from fibonacci numbers. I squared the sequence and extracted the constant value I found in my calculations, $(x \times 1.2720^{n})^2$.

Next I related combinations and probability to sequences. I created my own patterns of numbers beginning with the coin analogy, and experimented with various types of exponent patterns. Utilizing factorials and exponential values, I discovered a method for determining the total numbers of combinations a set of block could produce. This experiment led me into other areas of research involving such problems as diagonals in regular polygons, the composition of a sequence, the construction of segments from a set of linear points, and the principles of physics that involve patterns of numbers.

In conclusion, I can verify that patterns of numbers do play an important part in our activities. They form a basis for predicting the future and anticipating various steps to be taken in years ahead.

ANALYTIC DEVELOPMENT OF NOMOGRAMS BY COMPUTER THEORY AND PROGRAMMING

Ocasio, Wendell, Immaculate Conception Academy, Mayaguez, P. R. 00708;
279 Nelson Ramírez St., Mayaguez, P. R. 00708.

Nomography is the proceeding by which one can create a graphic graduate representation of the relationship between variables so that it can be obtained the numeric values of these which simultaneously satisfy the proposed relationships.

We had analyzed in a previous research four different classes of nomograms comparing its use with that of programmable calculators. The second phase consisted of adding four additional types and preparing a programmed system for microcomputers which analyzes any of the types studied and draws the corresponding graph with a plotter. We emphasize the nomography analysis by computer for studying the precision of different nomograms which solve similar problems; and for facilitating graphic preparation of nomograms that could be varied as desired.

The programs were developed in a Radio Shack Model 4 computer with BASIC vers. 01.00.00 and a plotter FP-215 and are prepared so that any user with some knowledge about computers and nomograms would only have to enter in the program the relationships between the variables, the limits and size of the nomogram desired to create it.

We concluded that BASIC programming can be used to prepared varied nomograms; that the study of appropiated nomograms that can vary could help to infer solutions of problems difficult to solve by contentional computer programs; and that the use of pgoramming would facilitate the teaching of the theory and practice of nomography.

QUICKLOG: SCHEDULING SOFTWARE FOR BROADCAST STATIONS

LaDuke, Steven P., Laporte H.S., Laporte, MN 56461
P.O. Box 21, Laporte, MN 56461

I have worked on my computer program Quicklog for almost a year. All of my original objectives, and many new ones, have been accomplished. Among the most important were: A) Automatic 24-hour time calculator. B) The Editor must be very powerful and simple to use. C) All commands are displayed that exist for input. D) Extensive Error handler does the dirty work for you.

The task seemed to be moderately simple at first. In three days, a usable version was made. Then I thought of an idea on how to improve Quicklog. I made the additions and changes. This has happened hundreds of times and still is happening now.

The average time required to create one day's log is two hours at KAWE. When using my Quicklog, the time has been reduced to only twenty-five minutes. That is an 80% decrease in time required. Thus Quicklog pays for itself!

The Public Television station that asked me to write the program is, KAWE of Bemidji, Minnesota. After finishing version 1.0, KAWE offered to sell Quicklog to other Public Television stations. Currently, several Quicklogs have been sold around the United States. We do expect more sales when version 2.0 is released.

Quicklog will be modified for other types of broadcast. The versions for IBM PC and Commodore 64 are also on the drawing board. Quicklog is only the first of several software packages for broadcast stations.

A NEW TWIST--FURTHER STUDIES OF THE MOBIUS BAND

Anne-Marie del Guidice, Socorro H.S., Socorro NM 87801
326 Church St., Socorro NM 87801

The *Möbius* band is the object that results when a strip of paper is given a half twist and made into a band or loop. If one draws a line along its surface it will travel over both "sides" before returning to the starting point. The edge will behave in the same manner. This demonstration proves the *Möbius* band to be a one-surfaced and one edged object.

Research done last year examined the properties of bands that were given varying numbers of twists and half-twists and how they behaved when they were cut into pieces longitudinally. Research this year shall focus on a three-strap variation of the *Möbius* band.

If a given band is oriented on a vertical axis, much like that of the earth, it can be said that the band is merely two straps connected to one-another at the poles. When another strap is added, it becomes a three-strap manifold, oriented on a vertical axis. Different numbers of twists can be put into each of the straps.

These three-strap manifolds were cut into halves and the resulting bands were examined for twists and knots.

The patterns apparent in the results led to several theorems which could predict the outcome of cutting a three-strap manifold in half, depending on how many twists are put in each strap.

#Scholarship - Ohio State University
Second Award - General Motors ISEF
Second Award - Mathematical Association of America

#A DIOPHANTINE ANALYSIS OF AN N-DIMENSIONAL PYTHAGOREAN THEOREM

Esser, John D., Connell H.S., Connell, WA 99326;
HC01 - Box 29, Mesa, WA 99343.

An n-dimensional Pythagorean theorem is represented by the equation $x_1^2 + x_2^2 + x_3^2 + \ldots + x_n^2 = x_{n+1}^2$. A Pythagorean m-tuple is a set of positive integers $(k_1, k_2, k_3, \ldots k_m)$ which satisfy the previous equation, where m represents the number of terms in the equation. The object of this project is to determine a general formula that will generate Pythagorean m-tuples.

Any method used to produce integral values for a given equation is termed Diophantine analysis. This particular analysis uses geometric representations to formulate the algebraic equations needed to solve the problem. Dividing the equation by the term x_{n+1}^2 we obtain an equation of the form $a^2 + b^2 + c^2 + d^2 + \ldots = 1$. The equation $a^2 + b^2 = 1$ represents a unit circle in two-dimensional space and the equation $a^2 + b^2 + c^2 = 1$ represents a unit sphere in three-dimensional space. Likewise, the n-dimensional Pythagorean equation can be represented as an n-dimensional unit "spheroid" in n-dimensional space. Each n-dimensional unit "spheroid" may be divided into (n - 1) unit circles. In each of these circles a line is drawn through the point (-1,0) and through an arbitrary first quadrant point. The slope of the line is then varied through positive rational values less than 1. This allows Pythagorean m-tuples to be generated.

A special case of Pythagorean m-tuples are Pythagorean triples (3-tuples). Pythagorean triples are three integers (a, b, c) which satisfy the equation $a^2 + b^2 = c^2$. The properties of Pythagorean triples, along with their relationships to other types of numbers is investigated.

#Fourth Award - General Motors ISEF

PROGRAMMING A COMPUTER TO MAKE DECISIONS:
THE FIRST PART OF THE GAME "RISK"

Jeff Mauldin, Highland H.S., 4700 Coal SE, Albuquerque NM 87106
1400 Girard SE, Albuquerque NM 87106

In this project I tried to find out if a computer could be programmed to make decisions and how well it could make these decisions.

I used the Parker Brothers game "Risk" to test this. The object of Risk is simply to take over the world. There are 42 countries, which are dealt out to the players. The players then commence placing the armies given to them on the board in order of their turns, three at a time. This is the part of Risk toward which my project is aimed. The player must place his armies so as to give him the best position possible---making many decisions along the way. He will eventually begin to attack and must set up accordingly.

The program I developed used a basic decision-making method to determine where to place the armies. I let it play several games against itself and played some against it myself. It played quite well, except for some stubborness; it wouldn't ever stop placing armies if it had competition in an area. Later I managed to correct this.

The next step for this project is pretty obvious: Program it to play the rest of the game. I could also try to adapt decision-making programs to more practical uses. Business would have a great use for decision-making programs, as would many scientific fields. Decision-making programs seem to have great potential. I hope I have realized and will realize more of these potentials.

COMPUTERIZED POLYNOMIAL ALGORITHMS

Badders, Daniel C., Creighton Preparatory School, Omaha, NE 68114
11824 Westwood Lane, Omaha, NE 68144

The purpose of my project is to demonstrate how a small personal computer can be programmed to work with polynomials. It is especially concerned with effectively applying synthetic substitution, the rational root theorem, the location principle, and several properties of derivatives.

The project was done on a Commodore VIC-20 personal computer with under seven kilobytes of available RAM. The limited memory made efficient programming necessary. The relatively slow speed of VIC BASIC made it advantageous to use some tricks for speed.

Synthetic substitution was first programmed. Because the computer can execute this algorithm very quickly, it can check possible rational roots, execute location principle, and graph polynomials quickly. Knowing the general formula for derivatives of polynomials allows the computer to find derivatives and work with them. By combining these capabilities, the program can find rational and irrational roots, slope, concavity, relative maximums and minimums, inflection points, and the area under a curve.

It was surprising to see how quickly the program could work with polynomials. For example, the program can find all five roots of $4x^5 + 12x^4 - 41x^3 - 99x^2 + 10x + 24$ in 1.8 seconds. This short time will be reduced further by rewriting the program in machine language.

Considering the program's fast, accurate results, small computers could be very useful tools for working with polynomials. This project suggests that a pocket computer could operate a similar polynomial program. In fact, programming a pocket polynomial calculator this way is a new goal for the continuation of this project.

ELEVATOR SYSTEMS: A MONTE CARLO SIMULATION

Gessler, Daniel, Poudre H.S., Ft. Collins, CO 80521
3205 shore Rd., Ft. Collins, CO 80524

The objective was to write a Monte Carlo computer simulation for elevator systems in large buildings. Such a simulation becomes extremely complex because part of the program is time controlled and other parts are event controlled: The entrance routine, which allows people to enter the building at random, yet at a give average rate, is time controlled. The boarding routine, which moves people from the lobby line to the elevator is time controlled. The delivery routine is entirely event controlled. It does a detailed calculation of the arrival times of all persons on their floors. This calculation starts when the elevator door closes and ends after calculating the arrival time of the elevator back in the lobby.

The main program is followed by some statistical analysis: The program calculates the amount of time that each person spent in line, and the total time required for each person to reach their floor. The program then plots the cumulative distribution function for the line time and total time. The program then prints the times that were not exceeded by 90% of the people. These times were used to measure system performance.

This program can be used to optimize elevator systems by changing the number of elevators, capacity, acceleration, and the maximum velocity of the elevators. This makes it possible to find a system that is efficent and not over-designed, thus saving office space.

#USERLINK: A PROBLEM ORIENTED PROGRAM GENERATOR FOR THE OSBORNE 1

Baughman, Jon Steven, Upper Dublin High School, Ft. Washington, PA 19034;
1217 Hawthorne Lane, Ft. Washington, PA 19034

Purpose: The purpose of this research project is to write a BASIC computer program for the Osborne 1 that will allow the user to create custom BASIC programs to solve any feasible problem, simply by responding to menu-friven prompts. The software should provide a simple alternative to learning a computer language to the novice user.

Hypothesis: It is possible to write a BASIC computer program to fulfill the above requirements.

Procedure: Experimentation to test the above requirements involves setting the goals to be accomplished by the program, and assembling of a list of commands supported in Microsoft BASIC, dividing this list into groups to make user access simple. Next, flowcharts and outlines must be created. The BASIC program must then be written, following the guidelines set by the flowcharts. Then, debugging and documentation must be completed. Finally, any possible additions to the program must be analyzed and implemented.

Conclusions: It is, indeed, possible to write a BASIC computer program to fulfill the above requirements. The 156K of software that resulted from experimentation can, in addition, act as a BASIC tutor, giving an English translation of the BASIC computer program being generated, and utilizes the Osborne's unique features. Possible expansions of the program may include BASIC instruction for the user, and translation of any BASIC program into a readable form.

#Honorable Mention - Upsilon Pi Epsilon, the National Computer Science Honor Society

#THE SENTENCE ADJUNCT TEST

Randall, Dana J., Stuyvesant H.S., New York, NY 10003
196-10A 65 Crescent, Fresh Meadows, NY 11365

One of the primary aims of mathematical linguistics is to determine the intuitive process used to learn languages by breaking sentences down into constituents. Therefore, I propose a new test for analysing sentences which shall be referred to as the sentence adjunct test. This test functions by taking the questionable sentence and inserting an adjunct between different pairs of words and seeing the meanings of the resulting sentences. Those sentences which follow logically when placed in the same contexts will be considered externally equivalent and will be placed in parallel parts of the tree structure representing the sentence.

With this test, certain divisions seem to occur, and it can be seen that every noun phrase (with the exception of those in clauses) which acts as a subject in the sentence will fall into the same first level of the trees. To account for the exceptions, I introduced the concept of sublevels, or leveling within levels. Thus, the first level or sublevel will be subjective, and the others will be objective.

With English sentences broken down in this manner, we can use this data to generate sentences. All structures of the same form which exist in the same objective or subjective class seem to be interchangeable. Thus, by applying these transformations, we can generate any variety of sentences from random, everyday communication.

#Second Award - General Motors ISEF

FEASIBILITY OF PRIMITIVE RECURSION IN PSUEDO-INTELLIGENT SYSTEMS

Mailhot, John N., Mainland H. S., Daytona Beach, Fl, 32014
12 Oakmont Circle, Ormond Beach, Fl, 32074

In computer-assisted problem solving, problems can be approached in two basic methods: the random trial-and-error approach, and primitive recursive trial-and-error. In many applications, random approaches will yield a solution in a reasonable amount of time: however, one cannot be certain if the result is the "best" answer or if there are other solutions yet unfound. Primitive recursive solution routines circumvent these drawbacks, but at the expense of time.

The problem selected for research purposes is the Pentomino problem: how to arrange twelve unique geometric pieces, each composed of five adjoining unit squares, into a 6 X 10 rectangle. There are 2339 solutions out of 10^{26} possible combinations. Evaluating one combination each second, all solutions would be found in 10^{16} centuries.

Through the use of work-reducing algorithms exploiting subtlties of the given problem, groups of combinations can be catagorically eliminated while retaining the primitive recursive structure, reducing the solution time to about one year. The marked increase in time efficiency makes primitive recursion a feasible problem solving technique.

#MATHEMATICAL OPTIMIZATION OF UNIFORM PARTITION SEARCH STRATEGIES

Hu, Alan John, La Jolla H.S., La Jolla, CA 92037
8422 Prestwick Drive, La Jolla, CA 92037

Given an ordered list of records, traditional search algorithms attempt to minimize the number of comparisons needed to locate a given record. On the other hand, given real-world storage devices, it would also be desirable to minimize the movement of the read/write head. The problem, therefore, is to find mathematically the optiumum search algorithm which minimizes search time spent reading records and traveling from one record to another.

An extensive review of literature has yielded much support for the need for this research, few algorithms which consider travel time, and nothing which addresses this problem.

Using calculus, algebra, and numerical methods, I was able to solve this problem for uniform partition searches on magnetic tape. Thus, I have the following results: (1) a function which returns the search time given a search strategy, (2) optimum solutions to this function for the special cases of no read cost and no travel cost which confirm the model, (3) the optimum solution for asymptotically large numbers of records, and (4) a specific solution for Knuth's legendary but representative machine, MIX.

#First Award - General Motors ISEF
First Award - Mathematical Association of America
Scholarship - United States Navy/Office of Naval Research
Honorable Mention - United States Army
Honorable Mention - Upsilon Pi Epsilon, the National Computer Science Honor Society

BALANCING CHEMICAL EQUATIONS (ALGORITHMIC METHOD)

Mason, Thomas G., Middletown H.S., Middletown, MD 21769
5519 Woodlyn Rd., Frederick, MD 21701

PURPOSE: To develop an algorithm (a series of steps that performs a certain task) that balances a variety of chemical equations. If that algorithm can be found, write a program (in PASCAL) to make the algorithm easy to use.

PROCEDURES: 1. The Algorithm
I tried to find similarities between the coefficients, subscripts, and charges of the ions. Assigning variables for the symbols and charges, the similarities were found and proven for each equation.
2. The Program
With the complex output of chemical equations, I realized several output routines were needed. PASCAL didn't have any conversion routines; these were made. Using the algorithm as a guide, the equation was arranged and simplified.

RESULTS: The resulting program produces a correctly balanced chemical equation at a rapid pace. No fatigue or boredom occurs when using this program.

CONCLUSIONS: The algorithm, whether used by a computer, or simply by memory, is a no guesswork way of balancing a chemical equation. PASCAL asserts its authority over unstructured languages through the use of PROCEDUREs, FUNCTIONs, TYPEs, and UNITs.

LEARNING CHEMISTRY

Hughey, Darryl W., North Pulaski H.S., Jacksonville, AR 72076;
131 Minnesota Cr., Jacksonville, AR 72076.

This project is a computer program based on a flowchart for naming inorganic compounds. It has a built in periodic table and 6 sections for learning and testing knowledge about chemistry skills. This program uses approximately 30,000 bytes of memory and includes custom characters for subscripted numbers. You can refer to the periodic tables and retrieve information on any element during the learning phase of the program. You may get this information on 103 elements. There are six skills to drill you on six different areas. There are approximately 200 questions between the six skills. When you answer, you must answer with the correct format. Including small letters, big letters, regular or subscripted numbers or the computer will indicate a wrong answer. After you feel comfortable with the skills, you may proceed to the flowchart or return to do any area. The object of the program is to teach and stregnthen ones knowledge of the chemical periodic tables, but could be easily modified to cover any subject matter. The age of computers is upon us and this is my interpritation of the learning abilities of our computer generation.

MAHSH, A NEW COMPUTER LANGUAGE

Hernández, Mauricio, Miguel Meléndez Muñoz High School, Cayey,P.R.00634;
P.O. Box 1740, Cayey, P. R. 00634.

MAHS, a new computer's language was introduced last year. The version presented that year had a problem; slowness in program execution. The goals for this year are: improve speed of program executions and to add new commands.

A compiler was introduced for improving execution. The Compiler translates a MAHSH written program into an equivalent BASIC (Most popular language for microcomputers) program.

An Editor was added too, for writing, correcting and saving MAHSH programs. Both, Compiler and Editor, are written in BASIC.

The new commands are basically oriented toward mathematics: matrix and polynomials operations; linear graphs and producing graphs of functions. The introduced commands allows with only one instruction, to realize tasks that usually needs three or four BASIC instructions.

The simplicity, brevity and power of MAHSH commands, makes MAHSH easy of learning. Moreover its instructions are spanish words, which also facilitate its learning. The majority of MAHSH applications, apart from an easy introduction to computers programming, are solving math problems related to polynomials, matrices and graphical representation of functions.

When this research was finished, the following hypothesis was verified: Using BASIC language, a program can be created that translated programs written in a new language to BASIC.

COMPUTER MATH

Addington, David P., Westview H.S., Martin, TN 38237;
316 Redbud Circle, Martin, TN 38237

The study of advanced mathematics and science requires an understanding of basic calculus. The repetitive operations involved in elementary calculus provide an ideal exercise for computer programming. The program which I have designed is capable not only of finding the first and second derivatives, but also is able to find the maxima and minima of function. In addition, the program shows the maxima and minima in terms of numerical approximations and graphs the original equation showing the maxima and minima over a user given interval. Not only does the program speed up elementary calculations, but it can serve as starting ground for new calculus students or a check for the advanced calculus student.

Aside from the main calculus program, I have designed a series of precalculus mathematics programs to more fully demonstrate the abilities of the computer. I wrote the programs in separate parts connected by a main program. The language I used was Applesoft Basic. The results were that the computer is very apt at any level of mathematics if it is properly programmed.

In conclusion, it can be said that the computer will very soon become a common tool in every level of study in mathematics.

#Alternate to Scholarship - Ohio State University

STREPTOKINASE: DISSOLVENT OR DISILLUSIONMENT?

Mooney, Charles R., Jr., Opp H.S., Opp, AL 36467;
708 King Ave., Opp, AL 36467.

This study was motivated by the knowledge gained by this researcher that the enzyme, Streptokinase, is in question among members of the medical profession insofar as its use in myocardial infarction therapy is concerned. Blood clots, commonly found in 90% of heart attack patients, can be affected by the prompt and properly administered dosage of Streptokinase. The purpose of this particular research was to determine if the blood type or Rh factor affected dissolution of thrombi. Blood specimens (45 cc) were obtained from eight donors having blood types A, B, AB, and O of positive and negative Rh factors. A-PTT's (a test used to determine deficiencies in coagulation factors) were run on each of these. Photography was then used to record visual evidence of the effectiveness of Streptokinase in dissolving blood clots formed in the 15 cc clotting tubes. The clotting tubes were observed and photographed at intervals of one hour starting 30 minutes after the blood was drawn.

The researcher found that neither the blood protein type nor the Rh factor appeared to affect the dissolution of the blood clot formation.

BREAKDOWN OF TISSUE FIBERS BY CANCER CELLS

Sharif, Ethel, Overton High School, Memphis, TN 38117;
2866 Getwell Road, Memphis, TN 38118

The objectives of this research are (1) to separate tumor cells from host tissue cells and (2) to determine the activity of enzymes released by the cells which might facilitate tumor invasion by breaking down the host tissues.

The cells were cloned and cell lines were established. The clones were transferred to petri dishes, seeded and allowed to grow for two weeks. Enzyme assays were performed on the media from the clones using radioactive skin collagen as a substrate.

The results showed that both cell types produce enzyme activity which required prior activation with trypsin. The tumor cells produced two times the amount of enzymes as the normal cells did. Therefore, it was assumed that this could be one possible reason for the invasion by the tumor cells. Thus, it was concluded that during tumor invasion both tumor and host tissue cells produced enzymes which can destroy the host tissue.

NET TRANSFERS OF LIPIDS BETWEEN PLASMA LIPOPROTEINS: A NEW BIOCHEMICAL INDEX FOR DETECTING HUMAN CORONARY ARTERY DISEASE

Davis, Ann R., Mather High School, Chicago, IL 60659
6251 N. Fairfield Ave., Chicago, IL 60659

PURPOSE: To devise a new procedure for measuring simultaneous in vitro net transfer pathways of lipids between lipoproteins of human fresh plasma and to determine whether any differences in these pathways occur in middle-aged males with coronary artery disease compared to age-matched normal healthy male humans.

PROCEDURE: Following informed consent, 10 ml blood samples were obtained from 12 middle-aged male patients with coronary artery disease and 12 age-matched normal male human volunteers. A new procedure was developed for measuring the extent of net transfer of unesterified cholesterol, esterified cholesterol and triglycerides between human plasma lipoproteins during a 4 hour incubation of fresh plasma at 37°C. This new procedure utilized cellulose acetate electrophoretic separation of plasma lipoproteins coupled with presently developed new "sandwich" methods for enzymatic staining of plasma lipoprotein-lipid bands.

RESULTS: A new biochemical index number for coronary artery disease, named the plasma lipoprotein-lipid transfer (PLLT) index, has been calculated from six plasma lipoprotein-lipid net transfer pathways which were found to be statistically different in middle-aged male patients with coronary artery disease compared to age-matched normal healthy male volunteers. The PLLT index averaged 9.27 ± 2.38 (mean ± S.E.M.) in 12 male humans with obstructive coronary artery disease and 0.54 ± 0.25 in 12 age-matched normal male humans, corresponding to a 1,617% increase in coronary artery disease ($p < 0.005$), with a 92% correct classification for the diagnosis of coronary artery disease.

CONCLUSIONS: The present data suggest that the PLLT index may have a possible use as an initial screening marker for coronary artery disease.

#First Award - American Medical Association
First Award - General Motors ISEF
First Award - Glenn T. Seaborg Nobel Prize Visit Award
First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent Office Society
First Award - United States Navy/Naval Medical Research and Development Command and Office of Naval Research
Second Award - United States Air Force
Alternate to Scholarship - United States Marine Corps
Honorable Mention - American Chemical Society

COMPUTER TUTORIAL ON FETAL ALCOHOL SYNDROME

Walz, Kelly J., Mahnomen H.S., Mahnomen, MN 56557;
P.O.Box 353 Mahnomen, MN 56557.

The purpose of writing this computer program was to inform of the dangers of using alcohol during pregnancy.

The program was created due to an interest in both computers and child development. Fetal Alcohol Syndrome was researched and the computer program was created. Information was found in various magazine articles, the March of Dimes, and encyclopedias. After the information was gathered a plan was created for the program. The program contained a pre-test and a post-test to inform the user of information learned and review needed. Following the pre-test were facts, symptoms, graphs, unanswered questions, and then the post-test.

The program was helpful in child development and family living courses and also used by the local F-H-A chapter. Those using the program felt it was informative and created concern for the unborn child and alcohol intake of the mother.

#Naegleria fowleri: 'In Vitro', 'In Vivo', and Intracellular Susceptibility to Four Antiprotozoal Agents.

Eward, Kathryn Leigh, Melbourne H.S., Melbourne, FL 32903;
5 Shore View Lane, Indialantic, FL 32901.

This project was designed to lay the foundation for developing a successful treatment for the disease primary amebic meningoencephalitis. This rapidly fatal cerebrospinal disease is acquired from the free-living amoeba Naegleria fowleri. This project entails four major divisions of study and experimentation over a four year period. The initial division included an extensive literary search and minimal inhibitory concentration (MIC) tests utilizing the amoeba Pelomyxa carolinensis and four antiprotozoal agents: amphotericin B, miconazole, rifampin, and tetracycline. Tests were designed to determine the agent with optimum inhibition efficacy. The second division included isolation attempts of Naegleria from fresh water, repetition of MIC (Pelomyxa) tests, and MIC tests with the Class III pathogen/causal amoeba N. fowleri. A spectrophotometry technique to measure agent effectiveness was developed. The third division (current research) includes repeated isolation attempts, development of optimum 'in vivo' (Naegleria) inoculation techniques, development of scanning electron microscope procedures, and intranasal inoculation/therapeutic treatment. Original decontamination techniques for Naegleria cultures were developed enabling the completion of immunodiffusion tests (ouchterlony plate tests) on infected, therapeutically treated mouse serum. The fourth division involved a quantitative analysis of the intracellular components (lipids, sugars, proteins) in Naegleria fowleri following agent treatment. Amphotericin B has indicated optimum absorption in all 'in vitro' testing. Amoebic trophozoites were isolated from fresh water. Intranasal inoculation of Naegleria produces PAME in mice. Intraperitoneal instillation does not. Techniques involving a quantitative measurement of intracellular lipids, sugars and proteins in therapeutically treated Naegleria were developed.

#First Award - American Medical Association
First Award - American Society for Microbiology
First Award - General Motors ISEF

#THE EFFECT OF THIOACETOMIDE ON CHINESE HAMSTER CELLS

Ashy, Cindy, Leesville H.S., Leesville, LA 71446
801 Kings Road, Leesville, LA 71446

Many occupational workers are exposed to cancer-causing agents everyday. It has been suggested that these agents cause cancer by inducing genetic abnormalities. The purpose of this research was to test the effects of thioacetamide (TAA), a known liver carcinogen, on the chromosomes of Chinese hamster cells. It was hypothesized that thioacetamide would induce chromosomal breaks since most other carcinogens do. The Chinses hamster was chosen because of its low chromosome number (only 22 makes the scoring in the metaphastic state much easier). A procedure was developed (modified from DeJong's) that allowed one to culture peripheral blood cells from the Chinese hamster. Modifications included a slower centrifuge speed because of cell fragility and higher amounts of phytohemagglutinin and mercaptoethanol. An established cell line, DON, was used. Two mg of TAA were used. At this level of intoxication, 77% of cells were viable after 12 hours using the trypan blue exclusion method. Slides were made and 117 good metaphases were studied. Only three breaks were observed which did not show a significant effect. A 24-hour study is currently being undertaken.

#Fourth Award - General Motors ISEF

#ELECTRICAL CELL HYBRIDIZATION AND THE DISCOVERY OF A NEW CELL LINE: PHASE I, DIELECTROPHORETICALLY INDUCED RECOMBINANT LUNG CELL FUSION; PHASE II, CORRELATION BETWEEN BIOELECTRIC POTENTIAL AND KARYOTYPE OF LUNG CANCER CELLS

Beglin, Robert M., Marquette H.S., Michigan City, IN 46360
P.O. Box 419, Beverly Shores, IN 46301

The purpose of this research was five-fold: to define the requirements for electrical fusion between normal and cancer cells; to establish a cell culture perfusion system; to measure the surface membrane bioelectric potential of normal, cancer, and hybrid cells; to determine the chromosome count, or karyotype of normal, cancer, and hybrid cells over several generations; and to determine if a correlation exists between chromosome number and bioelectric potential of all cell lines.

A perfusion system was designed to circulate Dulbecco's Modified Eagle Medium to maintain mouse normal lung and lung cancer cells at 37° C. The fusion chamber consisted of variable voltage and electrode arrangements to achieve dielectrophoresis and ultimately, fusion.

New cell lines were developed. Heterokaryotes, or binucleated fused cells, gave rise to mononucleated hybrids. Enough cells were hybridized so that some could be used to measure action potential, others for karyotyping, and the rest for counting through life cycle G_1,S,G_2, & mitosis.

Chromosome microtechniques counts were performed on all cell lines over cellular generations. The cells were arrested and harvested at metaphase through successive centrifugation, fixation, slide preparation, and photomicrography.

Micromanipulators guided three 1-micron tip diameter platinum microelectrodes toward a cell. Measurement of action potential involved a pulse stimulator, stimulating and recording electrodes, and a synchronized oscilloscopic camera.

Normal lung cells and normal/normal hybrids displayed an action potential about twice that of cancer cells and cancer/cancer hybrids. Hybrid cells lost chromosomes over mitotic generations. As the normal/cancer cell lost chromosomes, it decreased to that of a cancer cell.

#First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent Office Society
First Award - United States Army
Alternate to Scholarship - Ohio State University
Second Award - American Society for Microbiology
Second Award - General Motors ISEF

MANAGEMENT OF MATURITY ONSET DIABETES OF THE YOUNG (II)

Brandstein, Hali J., Woodbridge H.S., Woodbridge, VA 22192;
12120 Harbor Dr., Woodbridge, VA 22192.

This is the second in a series of original research projects dealing with the management of Maturity Onset Diabetes of the Young (MODY). MODY, or Type III Diabetes, is a rare form of the condition on which very little research has been performed. The ultimate objective of these projects is to develop an algorithm relating exercise, diet, and insulin in order to maintain blood sugar at a stable level in subjects with this condition. Last year, the research dealt with the relation between exercise and blood sugar. As a result of these early experiments, it became evident that the American Diabetes Association (ADA) Food Exchange Units, which are the cornerstone of the diet for all diabetics, may be inappropriate for use in managing the condition. Through a controlled set of experiments, it is demonstrated that supposedly equivalent foods have quite different effects on blood sugar levels. These results have far reaching implications for the treatment of all forms of diabetes. They demonstrate that traditional treatment may be in error while at the same time offering potential for development of improved forms of control.

COMBINATION OF HYPERTHERMIA AND CHEMOTHERAPY FOR CANCER TREATMENT

Dixon, Marnetta G., Sheridan H.S., Sheridan, AR 72150
Route 3, Box 116, Sheridan, AR 72150

The combination of heat and chemotherapy has shown promise in conquering cancer. Attempting to discover the most effective, yet least toxic, combination of hyperthermia and chemotherapy, a small animal model, consisting of 21 C3H mice, was devised. Both hind limbs were implanted with a RIF-1 sarcoma and treated with hyperthermia alone, chemotherapy alone, or hyperthermia and chemotherapy. Hyperthermia was performed by immersing the hind limb in a waterbath at 45°C for 15 minutes. Bleomycin was given in a dose of 50 mg/g of mouse weight. The tumor volume and the mouse weight were measured three times weekly. Hyperthermia alone (2.96±2.6 ml, ±s.d. volume of tumor at day 36) did not offer any significant advantage over control. Chemotherapy alone offered a slight, but not significant, advantage over control. The combination of hyperthermia and chemotherapy did offer a significant advantage, at days 27 (3.49±0.3), 29 (3.79±0.2), 33 (2.05±0.7), and 36 (2.32±0.2), over chemotherapy alone (4.92±0.8, 5.38±0.9, 4.76±0.1,3.39±0.8) at the respective days. Therefore, the combination of chemotherapy and hyperthermia offers an advantage over other treatments in this tumor system.

EXERCISE, INSULIN, AND BASAL METABOLISM

Bartos, Bonnie, Ketchikan H.S., Ketchikan, AK 99901
705 Cook Street, Ketchikan, AK 99901

Exercise should be important in everyone's life, but it is especially important for insulin management and control in the life of the diabetic. This computer program will calculate the Basic Metabolic Rate for any individual, that is, his or her caloric need for twenty-four hours of inactivity. A list of common exercises is given; selection of any one of them generates the calories needed to maintain that particular exercise for one hour. The graphics section is to aid the diabetic in scheduling exercise. The program is based on averages, and can be used effectively as a thought-conducive planning tool.

DOES ANTABUSE EFFECT THE MUTATION RATE OF DROSOPHILA?

Bachman, Brenda A., Bowling Green H.S., Bowling Green, OH 43402
139 Wolfly Ave., Bowling Green, Ohio 43402

The purpose of this project was to see if antabuse effects the mutation rate of Drosophila. Adult male flies were fed a solution of antabuse, 10% ethanol and 5% sucrose. A control, experimental control and no liquid control were also observed. All the males were bred and their offspring were observed for mutations. Antabuse is a drug used in the treatment of alcoholism along with various therapy. A recent study showed the combination of antabuse and nitrites in rat's diet caused tumors. This project proved that antabuse, at the concentration used, did not cause mutations in Drosophila.

#Scholarship - Otterbein College

A BEHAVIORAL EVALUATION OF MESOCRICETUS AURATUS NEONATES AFTER MATERNAL ETHANOL INGESTION

Pearcy, Clifford A., Monte Vista High School
Monte Vista, Colorado 81144
#5 Meadow Lane, Monte Vista, Colorado 81144

It was hypothesized that Mesocricetus auratus neonates would show increased activity levels and possible behavioral changes due to the exposure of ethanol in utero. The purpose of this study was to see if Mesoricetus auratus neonates exposed to a sole source of a 6% w/v with a .2% saccharin solution of ethanol would exhibit activity level and behavioral changes. 20 impregnated (Lak:LVG(SYR)) golden syrian hamsters were divided into three groups: Ethanol treated, Isocaloric control, lab-chow control. Treatment existed from day 2 through day 15 of gestation. On arrival, neonates were observed in open-field-like tests. A total of 80 neonates were produced, 64 of which were tested. Ethanol treated neonates exhibited tremendous increases in activity. Also, a high rate of tremors were recorded (18/29, 62%)and a low rate of hypertonia (4/29, 14%). Isocaloric and control neonates exhibited approximately the same levels of activity and relatively normal behavior. Due to tremor observations, it was possible to conclude that activity level changes were due to withdrawal symptoms from ethanol, which in past studies, has been indicated that tremors cause hyperexcitability of the central nervous system, therefore exciting the subject tested. To prove this, future research will involve a behavioral and brain biochemical analysis to alleviate the possibility of the ethanol inhibition of inhibiting neurotransmitters.

#EXTRACT OF ACHRAS ZAPOTA FRUIT AS A POSSIBLE ANTIN OPLASTIC AGENT ON EHS SARCOMA IN MICE.

Rodríguez, Víctor F., Dr. Pila M.S.
Ponce, Puerto Rico 00731
F-130 Perla del Sur, Ponce, Puerto Rico 00731

The focus of this study is to compare the effects of a natural product, The Achras zapota (Sapodilla) extract (CPE), and the antineoplastic agent Methotrexate (MTX) in the treatment of the EHS Sarcoma in mice. Tumor growing control, electrocardiographic (EKG), behavioral, teratological, toxicological, phytochemical, microbiological (bacteriological) and histopathological studies were performed. These studies were made using a Soft Tissue Sarcoma (EHS) transplanted in mice of the Balb/C strain. Tumor growing control studies demonstrated that CPE action as an antineoplastic agent is effective. The comparable values in EKG and behavioral studies showed no significant changes between CPE and the control group. However, significant changes were observed in EKG and the behavioral parameters when using MTX-Teratological research indicated that MTX could be a possible teratogen. Toxicological investigation showed that CPE toxicity is very low. Phytochemical and microbiological studies are in process. We anticipate that further studies about CPE may provide the basis for a new antineoplastic agent.

#Fourth Award - General Motors ISEF

STRESS AND CHOLESTEROL

REED, BRIAN C., Independence School, Bethel Park, PA. 15102
1082 Glen Oak Dr., Bethel Park, PA 15102

The researcher investigated the combined effects of variations in levels of dietary cholesterol and environmentally induced stress on the water consumption levels, heart pulse-rates, general behavior, serum cholesterol levels and arterial plaque deposits of male domestic rats.

Four groups of rats were used, one of which was a control group. Two serum cholesterol tests were made with blood samples drawn at the beginning and the end of the experiment. Three groups received stress through the use of a psychological low-electrical-voltage-conducting Shudder Box designed and constructed by the experimenter. Two of these stress groups also received, respectively, 2.8mg. and 10mg cholesterol daily. After 25 days, the rats were sacrificed and dissected; the aortas were stained with Sudan IV to show arterial plaque deposits.

For the three experimental groups, daily water consumption levels and heart pulse-rates increased. Behavioral changes in the three experimental groups included continuous attempts to escape, scratching and biting, irregular sleeping habits and fewer sleeping hours overall. Serum cholesterol increased significantly only for the low-level cholesterol and high-level cholesterol groups. In the Sudan IV Staining, all three experimental groups showed significant increases in aortic surface area exhibiting Sudanophilia (arterial plaque deposits).

The results indicate that the combination of dietary cholesterol and induced stress increases the observed factors. The experiment supports much of the present published scientific research on cholesterol, but it does not support stress as an independent causative factor.

ERYTHROCYTE SEDIMENTATION RATE: A NEW METHOD!

Emkey, Jennifer M., Holy Name High School, 955 E. Wyomissing Blvd. Reading, PA 19611;
1422 Old Mill Rd., Reading, PA 19610

The Erythrocyte Sedimentation Rate (E.S.R.) is the measure of rate of fall of erythrocytes contained in a vertical tube. This determination is useful in the practice of medicine and its accuracy is criticalsince many important therapeutic decisions are made on the basis of it. The most popular method in use today is the Westergren method which is reliable if the tube remains at 90 degrees for one hour. However, since many factors lead to tube displacement, it became necessary to look for an alternate approach. A suspension system was devised, theorizing that gravitational forces would keep the tube at 90 degrees. However, because of air current in the lab, the tubes could swing at times, leading to concern about the accuracy. Experiments were performed to assess the reproducibility of this method, to study the effect of tube angle variation on the E.S.R., and also the effect of tube motion on the result. Additional factors were evaluated. It was found that the suspension modification is highly reproducible and compares favorably with the Westergren method both with and without tube motion. Deviation of the tube angle from 90 degrees results in an increase in E.S.R. proportional to the degree of inclination. This method, therefore, seems to circumvent the problem induced by tube angle changes in the stationary system.

#Fourth Award - General Motors ISEF

#THE EFFECTS OF THE ADMINISTRATION OF FUROSEMIDE ON THE PLACENTAL STRUCTURE AND DEVELOPMENT OF RATS

Stoll, Karen E., Poplar Bluff Senior High School
Poplar Bluff, Mo. 63901
Route #7, Box 288A, Poplar Bluff, MO. 63901

The use of diuretics during pregnancy is common practice even though there is a direct relationship between maternal plasma volume and the status of fetal nutrition.

This project is a continuation of a study conducted by this researcher in which Furosemide appeared to reduce fetal weight. The purpose of this study was to determine if the administration of Furosemide to pregnant rats would cause placental structural or developmental differences.

One male and twelve nulliparous female rats were divided into experimental and control groups by random selection They were bred when vaginal smears indicated estrus.

Injections based on body weight were given both groups from day 4 of gestation through day 20 with experimentals receiving Furosemide and the controls receiving saline.

On day 21 the rats were sacrificed and the following weights taken: amnion and contents, fetus and placenta. Average experimental placental weight was 0.73 gm. Average control weight was 0.86 gm. Microscopic examination revealed marked congestion of the experimental placentas.

The Student's t Test performed to evaluate the difference between mean placental weight of experimental and control groups was significant at ($p<0.001$). A Chi-square Test performed on incidence of placental congestion was significant at ($p<0.005$). It appears the administration of Furosemide does cause placental structural and developmental differences in the experimental and control groups.

#First Award - American Veterinary Medical Association
Third Award - General Motors ISEF

THE CARCINOGENICITY OF ADDITIVES IN FILTER CIGARETTES

Andrew L. Kung, Lincoln H.S., Tallahassee, FL 32308;
2506 Blarney Drive , Tallahassee, FL 32308.

The object of this project was to study the "tar" of filter cigarettes, and determine whether or not certain components are carcinogenic in nature. The hypothesis of this research is as follows: certain additives found solely in the tobaccos of filter cigarettes form carcinogenic compounds, upon combustion, in the process of smoking.

The popularity of filter cigarettes has grown immensely since the 1960's, when medical evidence linked cigarette smoking with lung and heart diseases. Filter cigarettes remove a portion of the carcinogenic tar, but the filters also remove much of the desired "tobacco taste." To alleviate this, cigarette manufacturers have added flavorants to the tobaccos of filter cigarettes. The manufacturers, however, deem these additives, "secret ingredients," and refuse to reveal them to the public.

The research, simplisticly speaking, proceeded along the following four steps: condensation of smoke, fractionation of tars, analysis of tars, and biological testing of selected fractions.

The results of the research clearly proved the hypothesis true: there exist additives found solely in the tobacco of filter cigarettes, that form carcinogenic compounds upon combustion, in the process of smoking.

#First Award - General Motors ISEF

#TETRAHYMENA PYRIFORMIS: A NEW MODEL FOR CILIARY DYSFUNCTION IN MAN

Katz, Sara, The Baldwin School, Bryn Mawr, PA 19010;
701 Dodds Lane Gladwyne, PA 19035.

Cilia are microscopic organelles that line the human respiratory tract. Human ciliary dysfunction produces a vast amount of respiratory and other illness. The traditional animal model to study the problem, the mammalian tracheal explant, is costly and difficult to standardize. This project attempted to develop a new model, by employing cultures of the ciliated protozoan Tetrahymena pyriformis. Tetrahymena pyriformis was cultured under baseline conditions at 25°C in proteose peptone broth (GROUP I: CONTROL GROUP) and in chemically altered environments (GROUP II: TEST GROUP), ie. varying air, pH and exposure to automobile exhaust. Morphology and motility of cilia of both groups were studied by light and transmission electron microscopy. The data of these groups were then compared with photographs of normal cilia from rat trachea, normal human cilia, and abnormal human cilia. This study showed that cultural manipulation of Tetrahymena pyriformis constitutes a valid model for human ciliary disease. First, the cilia of Tetrahymena pyriformis grown under baseline conditions (GROUP I: CONTROL GROUP) were indentical by electron microscopy to the respiratory cilia of humans and rats. Secondly, electron microscopic ciliary abnormalities of Tetrahymena pyriformis were induced by altering its cultural environment using acid (pH 5.5) and exposure to automobile exhaust for ten minutes (GROUP II: TEST GROUP). Thirdly, abnormalities produced in Tetrahymena pyriformis were structurally identical to some ciliary abnormalities of human respiratory diseases. This new protozoan model has the potential of helping us to understand human ciliary dysfunction. As with all new models, it opens the door to future study.

#First Award - Eastman Kodak Company
Fourth Award - General Motors ISEF

DMSO TESTING WITH MALIGNANT CELLS INCLUDING EM

Wilkinson, Catherine, Fletcher Sr. High, Neptune Beach, Fla 32233
3621 Ocean Drive S., Jacksonville Beach, Fla 32250

Phase I experimentation revealed that the McCoy line of murine fibrosarcoma inoculated with concentrations of .5 and 1% dimethyl sulfoxide (DMSO) replicated at a higher rate than controls. In Phase II, concentrations of 1.5, 3, 6 and 24 percent have been tested at various volumes. Electron microscopy studies will also be included, yet this has not yet been completed. Because there is no record of this or similar experimentation ever having been conducted, a general hypothesis was made. It was hypothesized that DMSO would continue to increase replication rate of the cells until the toxic level is being approached whereupon a decreased replication rate will be noticed. Morphological changes are not expected to be identified without electron microscopy. Due to total lack of information in this field, the changes that may occur in cell ultrastructure cannot be precisely determined. Regular visual studies and cell counts, taken immediately after inoculation and again three days later, reveal that increased replication occurs up to concentrations of six percent. At a volume of two cubic centimeters of six percent concentration, there is a decrease in replication of those flasks with DMSO. The toxic level has been determined to be twenty-four percent at volumes of two cubic centimeters or higher. One practical application is that DMSO may be used as a supplement to culture media. Another theoretical one is that it may enhance chemotherapy, especially in slow growing tumors.

#NZB AUTOIMMUNITY: AUTOANTIBODY SYNTHESIS AND THE ROLE OF RETROVIRUSES AND IgD

Kerner, James D., Cheltenham H.S., Wyncote, PA 19095;
431 N. Sterling Rd., Elkins Park, PA 19117

Recombinant inbred (RI) strains allow a new approach to the study of autoimmunity in the New Zealand black (NZB) mouse, a model for human autoimmune disease. In the present research, linkage studies of roughly 300 mice representing NZB, C58, and the eleven NZB x C58 RI strains focus on identifying the genetic mechanisms and functional relationships of several known and hypothetical NZB autoimmune phenomena. The results point to the existence of two new autoantibodies (anti-IgD and anti-macrophage) and an autoantibody gene complex in NZB. The gene complex is roughly 11.5 cM in length and is flanked by the IgK light chain gene family and a 2.3×10^6 m.w. xenotropic murine leukemia viral (MLV) fragment; it contains three discrete genes (spaced at approximately 2.6 cM intervals) controlling the synthesis of autoantibodies specific for fibroblasts, tRNA, and macrophages, and is implicated as a primary cause of hypergammaglobulinemia. While antibody V-region structural genes were not found to be involved, the T cell alloantigen loci Lyt-2 and Lyt-3, involved with cytotoxic and suppressor T cell function, are logical candidates for the source of such autoantibody production. The gene initiating anti-single-stranded DNA autoantibody production was found to be within the approximately 9 cM region between another MLV fragment (m.w. 7.4×10^6) and the Hbb locus. No correlation was evident between viral expression and the incidence of any of the autoantibodies studied. The anti-IgD autoantibody observed was not associated with either B cell hyperactivity or hypergammaglobulinemia, offering no support for the possible role of anti-IgD immunoglobulin as a modulator of autoantibody synthesis in NZB.

#Second Award - General Motors ISEF

CALCIUM CHANNEL BLOCKERS

Ahmad, Fataima Z., Palatka H.S., Palatka, Fl. 32077
Rt. 5, box 501, Palatka, Fl. 32077

The purpose of this study was to examine the effects of calcium channel blockers on heart with various types of disease. Experimentation was conducted to examine the effects of calcium channel blockers on both the normal and disrythmic heart.

Testing procedure was as follows: A frog was anesthethised and secured to a disecting pan. EKG limb leads were attached, the chest opened and pericardium removed. Drugs were now administered to the heart with a small syringe. A total of ninteen frogs were tested.

Five baseline experiments were conducted in order to test the effects of each individual drug on the normal heart rate. Then calcium channel blockers were administered both before and after: (1) inducing tachycardia, (2) Inderol (beta-blocker) and (3) the other two calcium channel blockers. Inderol was tested: (1) before/after inducing tachycardia and (2) all three calcium channel blockers.

This research strongly indicates that:

(1) All three calcium channel blockers help to prevent any changes in heart rate when administered both before and after other drugs.
(2) Inderol helps to prevent large changes in heart rate when administered to the heart both before and after other drugs.
(3) There is no substantial difference between the heart rate changes induced/prevented by all three calcium channel blockers.

EFFECTS OF DIFFERENT ACID SUBSTANCES AT DIFFERENT PH LEVELS ON MICE

Crespo-Méndez, Aimeé, S.U. Maguayo, Dorado, PR 00646
Blq. 3 Lot 29 Sct. 2, Urb. Doraville, Dorado, PR 00646

A preliminary study on the effects of acid substances was done. Eight male white mice, Bal-C strain were grouped in five groups: Group A (control) was supplied with water; Group B with two mice drank instant orange breakfast drink at pH 5; Group C with two mice drank natural lemon juice. Group D and E with one mouse each had instant orange breakfast drink and natural lemon juice, respectively, both at pH 2. The mice were kept at natural photoperiod and room temperature. Food and liquid was fed on a daily basis.

No variations on behavior were observed except for Group B. These mice had hemorragic vomit, tremors and became sedentary. The urine pH was measured, ranging between six and seven, it showed no significant variations. The mice were weighted at regular intervals, two or three times during the experiment. The weight was not significatively different between the groups although a trend to lose weight was observed, being Group B the one with greatest weight loss.

Group B showed the most dramatic changes in physical appearance. The mice presented lacerations or wounds in the toes, tail, nose and pinnae. Some toes and tails were missing. There was hair loss, tumors on toes and nose, and eye cataracts. Group B showed tumors in the lungs and liver and stomach peptic ulcers. Group C also showed white tumors in the liver, although fewer and bigger. They showed some physical abnormalities similar to the ones previously described. However these were constantly less marked. Group A (control) showed none of these abnormalities.

#BHT*: ITS EFFECTS ON THE BODY AND MIND

(* butylated hydroxy-toluene)

Siegfried, Rae Ann, Camelback H.S., Phoenix, AZ 85016
2220 E. Cheery Lynn, Phoenix, AZ 85016

This project was designed to see if the food preservative BHT would have an effect on the normal activity and development of mice. The study, which was started in 1982, first focused on the effects of BHT on males and females. After finding the males more active than females the project was continued to see which age group of mice was more sensitive to the BHT. The experiment consisted of three age groups: Group A, 92 days at the beginning, Group B, 71 days and Group C, 52 days.

Two grams of BHT per liter of oil were used to saturate the food which was then fed as needed. Testing began one week after BHT was started and consisted of metabolism measurements, field study, Y maze learning rate, weight gain and organ analysis. The results indicated that Group B was more active and irritable. Group B also showed extreme increase in liver mass, but all three groups did show some degree of liver mass increase.

#Fourth Award - General Motors ISEF

HOSPITAL WRITER: A COMMUNICATION/TRANSLATING DEVICE FOR HOSPITAL PATIENTS

Buchla, Todd, Marysville High School, Marysville, CA 95901;
7593 Hwy. 70, Marysville, CA. 95901.

Persons who find themselves unable to communicate in hospitals because of loss of speech or language problems have an extra burden placed on them. This is particularly true of stroke victims who may be able to read but may have difficulty writing or speaking. This project seeks to alleviate this condition by making a simple to learn and use communicator particularly oriented toward the hospital patient. The idea is that a matrix of words is projected next to light-emitting diodes that are controlled by a joystick. Words are selected by lighting those diodes next to the chosen word. The entire vocabulary can be changed by simply projecting a different slide.

The communicator, which I have named HOSPITAL WRITER, was designed and built using TTL logic. All circuits were tested on "protoboards," then constructed permanently using copper printed circuit boards. Testing consisted of demonstrating the results to professional nurses and reviewing the design with a biomedical engineer. The engineer, Mr. Dan Trigilio, believes the project will have real success with stroke patients and would like to see it in a hospital.

THE EFFECT OF GLUCOCORTICORDS ON MUS MUSCULUS AND GALLUS GALLUS

Decker, Gina, Lexington High School, Lexington, SC 29072
214 Catawba Trail, Lexington, South Carolina 29072

This project is a three year study aimed at determining the effects glucocorticords have on such vital processes as the immune system and fetal development. Age and genetic factors were introduced to determine if such factors influence the way a glucocorticord effects the body and specifically the immune response. The method used to determine the effects of glucocorticords on the immune system was the analysis of abnormalities of the internal organs a pure strain (C-3-H) and a randomly bred strain (ICR) of Mus musculus. A mixed lymphocyte reaction was used to determine the extent of lymphocyte repression. The Mus musculus offspring were also observed for abnormalities. The project also investigates medications that have the same anti-inflammatory and immunosuppresant properties as glucocorticords. The medications were substituted for and compared with the effect of glucocorticords on the fetal development of Gallus gallus. It was found that these substitute medications have less severe effects on the developing fetus than medications which are glucocorticords.

AUDITORY ILLUSIONS

Randolph, Kimberly, Childersburg H.S., Childersburg, AL 35044
Rt. 1, Box 255A, Childersburg, AL 35044

No abstract received.

THE HEMATOLOGY OF A VIRUS INFECTION

Townsend, Henry B., Central High School East Campus;
Tuscaloosa, Alabama 35401; 2813 21 Street,
Tuscaloosa, Alabama 35401.

In this project I studied the effects of mouse adenovirus infection on the blood. My purpose was to show whether the virus had a significant effect on the white blood cells (WBCs) and the hemoglobin. The effects that the virus had on the mouse were similar to effects that a virus has on humans and produced significant changes in the WBCs and the hemoglobin. The procedure involved taking C3H/HeN strain mice and bleeding them for baseline values of WBCs and hemoglobin content. Next, the mice were injected with a dosage of 10^7 plaque-forming units of mouse adenovirus. This dosage was lethal in 90% of the mouse population. After a four day period the infected mice were bled again to observe the effects of the virus on the blood. Bleeding the mice involved the making of blood smears and collecting samples for quantitation on the Coulter counter and hemoglobinometer. The average WBC count before and after infection was 7.9×10^9 cells per liter and 5.3×10^9 cells per liter, respectively. The average hemoglobin value before and after infection was 15.5 grams per deciliter and 14.3 grams per deciliter, respectively. The results of this study demonstrated that the virus caused significant changes in both the WBC count and the hemoglobin values. The data obtained were tested using Student's t distribution test. My conclusion is that mouse adenovirus infection produced a significant change in the WBC count and hemoglobin value. The information gained from this project hopefully will help in the study of the effects, and possibly a treatment for, adenovirus infection.

COMPARISON OF THE CLEANING AND BACTERIOCIDAL CAPABILITIES OF SEVERAL COMMONLY USED DISINFECTANTS

Minjarez, Debra A., Loretto Academy H.S. El Paso, TX 79903
416 Kelvin Ave., El Paso, Texas 79915

The presence of blood/saliva on operatory environmental surfaces connotes the presence of unsanitary conditions, enhances the chances of cross-infection and potential contamination with pathogens. Unfortunately, reports of efficient decontamination materials have been limited. Therefore, thirteen surface disinfectants and sterile tap water were tested on their ability to eliminate blood and their bacteriocidal capabilities. Sterile squares of vinyl/upholstery served as the test surface. The squares were contaminated with human blood and Bacillus subtilis spores and allowed to dry. The cleaning of the samples was done with sterile gauze pads soaked in each testing agent and wrung out. Cleaned surfaces were sampled with sterile cotton swabs which were added to sterile saline. Aliquots were plated on agar for microbial growth. The remaining solutions were quantitatively tested for hemoglobin using the Hemastix Blood Assay (Ames, Co.) dip technique. After incubation, the colonies were tested quantitatively and qualitatively.

Experimentation indicated that bleach was the most effective blood cleaning and disinfecting agent, while Control III was the next best disinfectant. Spore removal/killing tests indicated that bleach and three of the glutaraldehydes were superior. Control III was slightly less effective. Tap water, iodophoralcohol and 70% ethanol were totally ineffective.

THE EFFECTS OF GLUCOSE AND SALT ON CHONDROSARCOMA GROWTH IN RATS

Wright, Gary L. , Summit Junior High School, Ashland, Ky. 41101
Rt. 2 Box 71, Ashland, Ky. 41101

The effects of feeding a high glucose or salt diet on cartilage tumor growth (Chondrosarcoma) in male Sprague-Dawley rats. Three groups of rats were selected as the control, sugar diet and salt diet. Each group was made up of two rats. The rats were fed regular Purina Lab Chow plus special compounds of 1% glucose and 1% salt in their drinking water. An adjustment period of ten days was alloted before weighing them. An injection, under the skin, of 1 CC Chondrosarcoma tumor suspension was given to the rats. The rats diet continued and they were observed for a total of forty two days. They were then weighed, sacrificed, and the tumors were removed. After weighing, the tumors were compared for size and body weight. Data was collected from the three groups for comparison. The tumor growth in the sugar diet group was less than the control or the salt diet group. The salt group also grew tumors nearly twice the size of the control group tumors. The salt group grew the largest and the largest mass of tumors. The sugar group grew the smallest and the smallest mass of tumors. The control group was between the two extremes. Dietary supplements may have a significant effect on tumor growth. The results of this study are not conclusive, however they suggest that either salt or sugar may have an effect on tumor growth.

#THE FRAGILE X CHROMOSOME: IN VITRO FREQUENCY CONSISTENCY

Kastin, Bruce R., New Dorp H.S., Staten Island, NY 10306
266 Moreland St., Staten Island, NY 10306

The Fragile X Syndrome is a newly discovered and very common form of mental retardation. It is defined by a marker or fragile site near the end of the long arm of the X chromosome. It may be as common as 1 in 1087 newborn males. While males with this marker chromosome are usually severely retarded, up to one third of female carriers may also be mildly retarded. There are several hundred reports in the scientific literature dealing with the Fragile X Syndrome, and by now hundreds of cases have been identified.

The frequency of cells showing the fragile X chromosome is variable. The range of reported fragile X (fra(X)) frequencies is from 4 to 70 percent, but few cases exhibit more than 50 percent of cells having the marker chromosome. Eberle et al. (1982) and Soudek et al. (1984) reported that fra(X) frequency is relatively consistent within the same individual, but differs between individuals and families. The basis for this consistency and variation is unknown.

The experiments in the present study were carried out to further investigate fra(X) frequency consistency. The present investigation adds new information by showing that fra(X) frequency is generally consistent for the same individual both over time and within replicate cultures. This information is of significant value in contributing to a better understanding of the variability which underlies fragile site expression. It is important basic information which can contribute to the development of more effective tests for the diagnosis of the Fragile X Syndrome.

#Fourth Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

EXPERIMENTATION ON THE FEASIBILITY OF GERM RESISTANCE IN CHILDREN'S CLOTHING - A TWO YEAR STUDY.

House, Vickie L., Laurel County Jr. High School, London, KY 40741; Rt. 6 Box 551 London, KY 40741

The study for this project was done through four different experiments. The first dealt with the treatment of cloth with hydrogen peroxide and one of four chemicals: zinc oxide, zinc nitrate, zinc sulfate, sodium acetate, after which it was washed twice. The cloth was then contaminated with varying types of bacteria and allowed to incubate for twenty-four hours. Upon examination it was found that the cloth treated with hydrogen peroxide and zinc sulfate killed the most bacteria. However, the germ resistance was less effective after washing.

In the second experiment the researcher added the chemicals to the detergent in order to wash in the germ resistance instead of washing it out. It was found that the level of the germ resistance was not affected by this.

In the third experiment the cloth was treated with the chemical only. This was done to check the effectiveness of the chemical without the hydrogen peroxide. The addition of hydrogen peroxide seems to make little difference in the germ resistance with zinc sulfate. With the other compounds the hydrogen peroxide seems to improve its resistance.

In the fourth experiment, the treated cloth was placed on the shaved area of a rabbit's skin. This was done to determine whether the cloth would be harmful to the skin of a small child. No skin irritation was observed.

Other tests were run to check the effect of the chemicals on the flame resistance of the cloth. The flame resistance was rendered useless by the treatments.

*CARDIAC EFFECTS OF BETA-ENDORPHINS

Reinertsen, Kerry K., Ridgefield H.S., Ridgefield, CT. 06877
90 Fieldcrest Dr., Ridgefield, CT. 06877

It is known that beta-endorphins have a depressant effect on the circulatory system in states of stress. This is thought to be mediated by the effect of beta-endorphin on the central nervous system. It is not known, however, if there are beta-endorphin receptors in the heart or coronary circulation. To test the hypothesis that beta-endorphins can alter cardiac heart rate, contractility, or blood flow due to stereospecific receptors in the heart, seven rats were studied. A Langendorf type preparation was used in which the heart was removed and perfused with an oxygenated physiologic buffered salt solution. Contractility was measured with sonomicrometer crystals, and coronary blood flow was monitored with an electromagnetic flow probe. After the preparation stabilized, the perfusate was switched to one with beta-endorphins. Beta-endorphin produced a 28.1% decrease in coronary blood flow ($p < 0.05$). No significant change in heart rate was associated with the beta-endorphin infusion. In two hearts the effects of beta-endorphins were reversed with Naloxone, a specific opiate antagonist. It was concluded that beta-endorphin receptors are present in coronary circulation and that activation of these receptors causes significant coronary vasoconstriction.

*Third Award - General Motors ISEF
Alternate to Scholarship - Ohio State University
Honorable Mention - United States Air Force

AN IN VIVO ANALYSIS OF THE EFFECTS OF THYROXINE APPLICATION IN MURINE MUSCULAR DYSTROPHY

Crawford, Brett A., Baton Rouge High School,
Baton Rouge, La. 70806
12338 N. Oak Hills Pkwy. Baton Rouge, La. 70810

Murine muscular dystrophy caused by the inheritance of a mutation at a single locus exhibits many of the abnormal features also found in the human muscular dystrophies. Associated with this neuromuscular disorder are the degeneration of muscle fibers, apparent intracellular ion imbalances, lower than normal resting membrane potentials, and a myotonic-like activity induced by the repetitive firing of the motor neurons, primarily in the biceps femoris and gastrocnemius muscles of the hind limbs. Previously, much research has focused upon attempting to make the Na-K imbalances conform with improved motor control of the hind limbs through the injection of mild depressants such as diphenylhydantoin (phenytoin), but unsuccessfully. Conversely I attempted to reverse the atrophy and pseudomyotonia of the dystrophic muscles by balancing the internal and external Na-K concentrations with an injection of thyroxine, which because of its metabolically stimulative properties increases the activity of the membrane Na-K pumps, hyperpolarizing the membrane and thus effectuating substantially higher resting potentials for the muscle fibers.

Using micropipette electrode techniques a significant 9% increase in the membrane resting potentials was demonstrated by the dystrophic mice treated with thyroxine, elevating the potentials to near normal levels just as expected. With an electromyograph the frequency of spasmodic contractions by the hind muscles was recorded to determine the hormone's propensity to reduce the myotonic-like activity. It was found that a 29% decrease in the rate of contraction could be displayed with a solitary injection of thyroxine, with its effective duration being about 6 days while only 5 days for the normalization of the membrane potentials.

#First Award - American Veterinary Medical Association

INVESTIGATIONS INTO THE CYTOTOXICITY OF HEMATOPORPHYRIN DERIVATIVE

Gastreich, Karin R., Shawnee Mission West H.S., Shawnee Mission, Ks. 66212;
8344 Hadley, Overland Park, Ks. 66212.

The student conducted a two-part study of the cytotoxic properties of hematoporphyrin derivative (HpD). HpD, a chemical used in photoradiation therapy for cancer, has been observed to induce cytotoxicity upon exposure to light. The initial hypothesis stated that if HpD was administered to V79 cells (Chinese hamster lung fibroblasts) in vitro without exposure to light, then it would not affect viability, but would cause a dose-dependent inhibition of colony formation. V79 cells were treated in vitro with varying concentrations of HpD. All treatments were performed in darkness, and cells were incubated in darkness at 37°C. HpD showed no effect on viability up to 100 ug/ml, the highest concentration tested. In the survival assay, cells receiving HpD survived until treated with 50 ug/ml for 7 days. The second study involved the use of an HeNe laser. The initial hypothesis stated that if V79 cells received no HpD or had no time for HpD uptake, then they would survive laser exposure. Laser alone did not harm the cells, but the surviving fraction of V79 cells treated in suspension with 100 ug/ml just before laser exposure dropped to 0.01 after five minutes of illumination. In later tests, a 3 hour pretreatment and subsequent removal of HpD proved less effective in some cases then the presence of the dye during illumination. This contradicted the student's initial hypothesis and the assumptions of other researchers that cellular incorporation was necessary for HpD-induced cytotoxicity.

THE EFFECTS OF GLUCOSE AND TRYPTOPHAN ON THE ENDURANCE OF MICE

Wehling, Andrew A., Palmyra High School, Palmyra, MO 63461;
RR 1, Box 250, Palmyra, MO 63461.

It has been suggested that high consumption of sucrose may have adverse effects on the endurance of people. This project was designed to test this substance, and find its effects on endurance. Consuming large amounts of sucrose leads to a high level of glucose in the blood. This stimulates insulin, which brings down the level of not only glucose but also of amino acids. Tryptophan, a rare amino acid, is least effected by insulin, therefore, is left with fewer other amino acids to compete with to cross the blood-brain barrier. Tryptophan is a precursor of serotonin, a neurotransmitter that causes sleepiness. Increased amounts of tryptophan in the brain allow increased production of serotonin, leading to a sluggish, lethargic state.

To determine at what point after intraperitoneal glucose injection the blood-glucose level is highest, 5 mice were injected with glucose, tryptophan, or distilled and sterilized water on three successive days, using a different substance each day. Blood glucose was tested just before, just after and in 20 minute intervals after injection for one hour. Three tests were then conducted on 12 mice, using either water, glucose, or tryptophan. One half hour after being injected intraperitoneally with one of the substances, the mice were forced to swim and were timed. Based on data from this and previous experiments, glucose administration results in a hyperactive state, followed by a lethargic state. Tryptophan, in a previous experiment, caused the same effects as glucose, though not as pronounced. In this experiment, however, the tryptophan had no noticeable effects, possibly because not enough was administered, or because the stress of the experiment had a greater effect on blood chemistry than did the tryptophan.

THE HIPOGLYCEMIC EFFECT OF THE PIGEON PEAS COFFEE (CAJANUS CAJAN) ON DIABETIC RATS

Rodriguez, Guillermo E., Maria Auxiliadora Private School
Carolina, Puerto Rico 00628
Calle 82 Blq. 108 #36, Villa Carolina, Carolina, Puerto Rico 00630

There is a great percentage of people that suffer the sickness of Diabetic Mellitus. This motivated the author of this investigation, which was performed at the Laboratory of Colegio María Auxiliadora.

During the first phase of this investigation it was definitely proved that the abstract of the pigeon peas coffee acts like the hypoglycemic of the coffee. The mellitus is up to 50% less than the normal level.

The second phase of the investigation started to characterize the compound of pigeon peas coffee carrying out different types of chemical studies. An infrared analysis was performed where the component of the substance, which provokes the pigeon peas coffee to act as a hipoglycemic agent, was not clearly distinguished. Afterwards a comparative study between the insulin and the pigeon peas coffee concluded that probably the high degree of proteins is what makes this substance act as a hypoglycemic.

This investigation is still in process, the following procedure consists of different types of chemical studies, an analysis of chromatic liquids, an electrophoresis of proteins and the method of thin layer.

THE REDUCTION OF VITAMIN K-DEPENDENT CARBOXYLASE THROUGH ANTIBIOTIC THERAPY

Graham,Jeffrey.,Wade Hampton H.S.,Greenville,S.C. 29609
205 Maco Terrace.,Greenville,S.C. 29607

Vitamin K plays an important part in the coagulation process by carboxylizing glutamyl acid residues in the prothrombin molecule.Noncarboxylized residues result in defective binding of prothrombin to phospholipid and the prolonging of the clot time.Antibiotics effective against Bacteroides fragilis,the bacteria that synthesizes vitamin K in the gut,may prolong the clotting time by reducing carboxylase production.A group of mice were given oral injections of chloramphenicol,tetracycline and cleocin,while a second group was given these same antibiotics with a dosage of aquamephyton added.The blood was collected by heart puncture ,and also the clotting time was measured by Quick's prothrombin time,which determines vitamin K deficiency.The control group had an average clot time of 25 seconds compared with 310,70,and 26 respectively for chloramphenicol,cleocin ,and tetracycline.Tetracycline was used because anaerobes are resistant to it.The vitamin K added group had an average time between 20 and 25 seconds.The experiment proves that antibiotics prolong clotting time by reducing the carboxylase able to bind with prothrombin.The error margin is 13 seconds.This experiment also suggests that in certain cases vitamin K can be used to alter abnormal clotting times to reasonable levels.

TERATOGENIC AND MUCOCUTANEOUS CHANGES AS A RESULT OF ACCUTANE

Bellian, Kenneth, T., Hayfield Secondary School, Alexandria, VA 22310
8019 Apollo St., Lorton, VA 22079

This experiment will show the teratogenic effects to newborn mice, when the female is on Accutane during the pregancy. In addition to this test groups of male and female mice will be administered Accutane, then dissected to compare the differences in organ size and development of calcification. Looking at the mucocutaneous side effects, their frequency, and treatments to control irritation. Accutane was administered to 25 males and 25 females mice for a duration of 3 weeks at 1mg/kg/day. The dosage was scaled down to each mouse then multiplied by 20 for experimental purposes. These mice were approximately 4 weeks old. After 3 week they were sacrificed by inhalation of ether, then dissected for a comparative study of organ size. For the teratogenic effects 5 males and 5 female mice were mated while the females were on Accutane. After the birth of the newborns, they were checked for abnormalities. When looking at the selected organs there was some differences in size between the control and experimental mice. The male testes showed a loss of size and atrophy of tubules. The birth defects which were present, hydrocephalus, microcephalus, micropinna, and pheochromocytoma are usually incapable with life. The mucocutaneous effects are bothersome and very common to most patients. Problems like Cheilitis, Xerosis, and Epistaxis are the most common, fortunately these can be controlled with ointments and ltions. Accutane should be used for the severe cystic and nodulcystic acne, and the patient should be placed under tight scrutinization in order to catch early signs of adverse side effects. Most mucocutaneous side effects are very irritating, fortunately various ointments can help relieve them. Since teratogenic effects were witnessed, the females should be aware of the risks and the proper courses of action to take if problems do arise.

BODY DENSITY

Kummet, Jay, Healy H.S., Pierz, MN 56364
120 Main St. , Pierz, MN 56364

The calculation of body density, by water displacement, is cumbersome and some other methods have been devised to avoid the equipment neccesary for such an experiment. Since density is simply mass divided by volume the main problem becomes one of calculating volume. The computer program divised takes 8 various measurements of the body then computes body volume. The results of this program was compared to water displacement to calculate percent error.

#DIETARY SUPPLEMENTS OF VITAMIN E AND BLACK SEAWEED: THEIR EFFECT ON CHOLESTEROL RATES

Pui Chi Cheng
Spartanburg High School
297 Heathwood Drive Spartanburg, SC 29302

The purpose of this project was to determine dietary supplements to reduce the cholesterol level in the blood. Vitamin E and black seaweed were used in the experiment because they display properties similar to high-density lipoproteins, produced by the body, which are supposed to reduce cholesterol in the body. In the experiment, rabbits were used as the experimental animals. They were placed in their experimental groups receiving their proper diets of lard coated food and supplements od vitamin E and black seaweed for six weeks. From this project, both vitamin E and black seaweed have been able to reduce the cholesterol level in the blood and seaweed has been to be more effective than vitamin E.

#Second Award - General Motors ISEF

THE EFFECTS OF VITAMIN A ON LABORATORY WHITE MICE

Egly, Lori A., Belfield H.S., Belfield, ND 58622
Box 53, Belfield, ND 58622

Vitamin A has been the topic of controversy recently. My project was done to see what effects the vitamin would have in white mice in the areas of behavior, physical appearance, and the effects on the internal anatomy, studied through autopsy. I divided six mice into three catagories: two mice injected with 10 units every three days, two mice injected with 15 units every three days, and two mice used as control mice with no injections.

The results showed: 1. Vitamin A caused the loss of hair on the thigh area. In one case, it also caused hair loss around the eyes and under the mouth; 2. Vitamin A caused the eyes to close shut; 3. It caused the folding of the ears.

The vitamin might have also been responsible for: 1. Varying colors of the liver; 2. Discoloration of the kidneys; 3. In one case, the shrinking of a kidney.

A COMPARATIVE STUDY OF BLOOD SUGAR LEVELS IN WHITE RATS USING ASPARTAME, SACCHARIN, AND SUCROSE

Shelli O'Connor, St.Clair H.S., St.Clair, MN 56080
St. Clair, MN 56080

The purpose of this project was to determine blood sugar levels in white rats exposed to supplements of aspartame (Nutra Sweet), saccharin, and sucrose(sugar).

The white rats were encaged in identical restraints and were fed water and food daily. Cages were cleaned weekly. Food and water intake were determined and recorded for each rat.

Blood sugar levels were taken from each rat prior to the supplements for four weeks. This was then determined to be the average blood sugar levels for further testing.

Rats were then paired for mating at the close of four weeks of testing for average blood sugar levels prior to the dietary supplements. Approximately three weeks later offspring were born and their blood sugar levels were also taken.

Blood sugar levels that were taken and measured during the intern of this experiment with these particular vertebrates, demonstrate that dietary supplements do not significantly alter blood sugar levels in each rat. It would appear that variables in blood sugar levels are due to many additional factors such as: stress, pregnancy, hormonal regulations, age, change in cage mates, and innate biochemical reactions with each speciman.

OXYGENATION CAPACITY OF NATURAL VS. ARTIFICIAL BLOOD

Green, Deborah K., Bonneville H.S., Ogden, Utah 84403
4402 Jefferson Ave., Ogden, Utah 84403

My project is to determine if normal human red blood cells are more efficient than hemoglobin solution and perfluorochemical emulsions in carrying oxygen.

I tested my blood, three synthetic blood controls-acidosis, alkalosis, and normal, and a hemoglobin solution on a Blood Gas Analyzer. I made the hemoglobin solution using a monobasic sodium phosphate buffer in the three different dilutions. I tested the three solutions and the pure hemoglobin. Using a tonometer to add oxygen into the samples, I oxygenated them for three different time limits-one minute, two minutes, and five minutes. After all samples had been oxygenated, I tested them on the Blood Gas Analyzer. I graphed the amounts of oxygen placing the hemoglobin solutions on one graph, my blood on another, and the synthetic blood controls on another. I observed that the graphs were very similar. The second sample of my blood increased between one and two minutes and then decreased. The first sample is similar to the alkalosis and normal synthetic blood controls, and the 1:10 ratio of the hemoglobin solution because the amount of oxygen decreased. Sample number two of my blood is similar to the acidosis and straight hemoglobin and 1:1 ratio of the hemoglobin solution.

My results show that the oxygen carrying capacity of artificial bloods are similar to human blood.

#THE EFFECT OF D-GLUCOSE ON CARDIOVASCULAR RESPONSES TO STRESS

Rooney, J. Garry, Rockledge H.S., Rockledge, Fl. 32955;
P.O. Box 213, 1256 St. Andrews Dr., Rockledge, Fl. 32955.

Stress, the nonspecific result of any demand upon the body, is known to be an important factor in the development of heart disease. In today's society, individuals experience stress in their daily living. Prolonged stress can trigger biological imbalances such as abnormal response to sugar. Cardiovascular responses to stress may be affected by the ingestion of large amounts of sugar. D-glucose, the simple sugar dextrose, is the most important carbohydrate in body metabolism. While research has shown that blood pressure and heart rate can be increased by stress, no hard data has been found to show the effect of sugar on cardiovascular responses to stress.

The purpose of this research is to study whether sugar further increases cardiovascular responses to stress. The hypothesis of this research is the D-glucose will further increase blood pressure and heart rate under stressful conditions, both physical and psychological.

Twenty male adolescent subjects were given a D-glucose solution or a placebo drink (random administration, counter-balance method, double-blind procedure). Blood pressure and heart rate were monitored during psychological (mental arithmetic task) and physical (cold pressor) stress periods and during the recovery rest periods.

Besides blood pressure and heart rate, pulse pressure, cardiac output, and double product were also studied. The data showed very significant increases in heart rate, systolic blood pressure, pulse pressure, and double product. Cardiovascular responses also remained elevated during rest periods. Since the data collected shows significant results, further research is planned.

#Fourth Award - General Motors ISEF

THE SYNERGISTIC EFFECTS OF VITAMINS E AND C ON THE MUTAGENICITY OF CIGARETTE TAR

Curry, Tracy D., Merritt Island H.S., Merritt Island, FL 32953;
2096 Otterbein, Cocoa, FL 32922.

The awareness that chemicals in the environment can bring about changes in human heredity processes is relatively new, although the fact that exposure to radiation or emissions from radioactive sources can cause genetic changes (mutations) has been known for half a century. One of the simplest tests for assessing the mutagenic properties of chemical compounds is the Ames Assay. The test utilizes a variety of mutations of the histidine operon in Salmonella typhimurium, such that histidine can not be synthesized by the organism. Growth on histidine free medium is indicative of a back mutation resulting in normal histidine biosynthesis. The purpose of this project is to test the possible protective qualities of two substances against the back mutation caused by the mutagen cigarette tar. The two protective substances used were ascorbic acid and α-tocopherol. It was hypothesized that ascorbic acid and α-tocopherol or the combination of both would show protective qualities. A concentration of α-tocopherol and ascorbate at the recommended daily allowance for humans in g/kg was used. Negative controls were used to test the normal reversion rate, and a positive control of the mutagen, cigarette tar, was utilized to show that all systems were functioning. Reversions were scored by platting the strains in a histidine free nutrient agar. α-tocopherol and ascorbate used singly showed no significant anti-mutagenic effect. A sysnergistic effect between the two was found, however, in that there was a significant reduction of back-mutations caused by the cigarette tar.

THE EFFECTS OF MEAL SKIPPING ON PHYSICAL ACTIVITY

Yanish, Karla J., Mahnomen H.S., Mn 56557;
RR1, Mahnomen, Mn 56557.

This project began when wrestlers were observed skipping meals and fasting to make weight. Possible reduced physical activity was hypothosized as due to lack of nutritional intake.

Subjects ate breakfast and lunch and at 3:30 p.m. were tested on three physical activities. Two days later they skipped breakfast and lunch and were again tested on the same activities.

Activities were counted and pulse rates recorded, before, immediately after, and 5 minutes after the activity commenced. Each subject ran laps for 5 minutes, jumped rope for 1 minute, and performed sit-ups for 1 minute.

Data was compiled by use of a microcomputer. Average increased activity for females after eating was: laps run +2.1, rope jumpes +15.3, and sit-ups +6.8; and for males: laps run +1.4, rope jumpes +11.5, and sit-ups +6.8. Average pulse rates were lower for females after eating as follows: before laps run -7.5, 5 minutes after laps run -8.0; before rope jumpes -2.5, 5 minutes after rope jumpes -2.0; before sit-ups 7.0, and 5 minutes after sit-ups -12.0. Average pulse rates were lower, in most cases, for males after eating, as follows: before laps run -1.0, 5 minutes after laps run -7.0; before rope jumpes -2.5, 5 minutes after rope jumpes -8.0; before sit-ups -6.5, and 5 minutes after sit-ups -3.7.

In conclusion, the data indicated an overall increase in physical activity after eating and lower pulse rates after eating.

#IMMORTALIZING HUMAN LYMPHOCYTES

Brundage, Robert A., Horton Watkins H.S., St. Louis, MO 63124;
2 Whitfield Lane, St. Louis, MO 63124.

Thymus-derived lymphocytes are each specific for one antigen. In a normal human, one out of 1,000,000 to 10,000,000 T-cells binds a given antigen; in research, such a small reaction is indistinguishable from inherent error. The purpose of this study is to create one or more immortal, syngeneic T-cell lines such that all cells in these lines bind trinitrochlorobenzene (TNP), an antigen not found outside the laboratory. A TNP-human serum albumin (HSA) conjugate was created and dialyzed against water to remove excessive TNP. In addition, a macrophage-TNP conjugate was created by incubating macrophages in a TNP-saline solution. The TNP-protein and the TNP-macrophages were tested against each other and against phytohemagglutinin (PHA), a known mitogen, in their ability to cause cell proliferation in groups of control and of known TNP-sensitive T-cells. It was discovered that control cells proliferated in response to PHA, but not in response to TNP. The TNP-sensitive cells, however, taken from a subject with previous immune reaction to TNP, showed the most proliferation in response to TNP-macrophages or PHA and less to TNP-protein. Since proliferation indicates specificity for the stimulus used, this result showed that the TNP-sensitive cells were specific for TNP. Lymphocytes from the TNP-sensitive donor were stimulated with TNP-HSA or TNP-macrophages; those incubated with TNP-HSA were fused with a cancerous T-cell line and those incubated with macrophages were cloned.

#Third Award - General Motors ISEF

FORMALDEHDYE EXPOSURE AND ITS EFFECTS ON MICE

Swenson, Mary M., Sundance H.S., Sundance, WY 82729;
Star Rte. 5 Box 22, Sundance, WY 82729.

Purpose: The intent of this project was to discover the effects of formaldehyde on mice and to correlate these with previous research and effects on humans.
Procedure: Albino mice were kept in aquariums to keep the formaldehyde concentrations (.04 and .10 ppm*) constant. For the air exposure, formalin solution was placed on filter paper and hung in the cages which were cleaned weekly and this procedure repeated. These levels were maintained for 2.5 months. A drop of 1% formalin solution was placed on the back of the neck of the skin exposure group every three weeks. The mice were posted and tissues preserved and sent to the Clinical Lab of the Black Hills, where slides were made of them. Dr. Bloemendaal examined the tissues with me for pathologic changes.
Results: Lung tumors were found in 50% and lung inflammation in 100% of the mice exposed to formaldehyde in the air. No abnormal tissues were found in either the skin exposure group or the control. Fatty liver tissue was incidentally discovered in one exposed mouse.
Conclusion: This 2.5 month exposure for mice would correspond to approximately a 7.5 year exposure for humans. This experiment would seem ot indicate that levels of formaldehyde below the NIOSH ceiling may cause serious health problems.

*parts per million

SELECTED PROTEIN AND ENZYME DETERMINATIONS IN HUMAN SALIVA

Gaddy, Glen David, McLean High School McLean, Va. 22101
6527 El Nido Drive, McLean, Virginia 22101

Saliva is largely unexploited as a body fluid for medical diagnostic purposes. Additional knowledge of the salivary proteins' origin and physiologic function may provide quantitative monitoring and a convenient and noninvasive means for diagnosing various disease states and measuring pharmaceutical treatment effects. The procedures were developed to produce the most precise and repeatable results possible. This study required the determination of total protein content, the presence of alpha-amylase, and the isozymes of alpha-amylase. Both whole and parotid saliva was collected by a Lashley cup process, it was lipolized, dialyzed, and centrifuged for purification. A Lowry protein assay, a alpha-amylase assay, and a procedure which separated the saliva by molecular weight using a disc gel electrophorsis technique was performed. Finally, the determination of the isoamylase concentration by an agar-starch plate method was completed. The results showed a multitude of similarities in salivary proteins. The study produced three original observations, protein content of saliva decreased as flow rate increased, saliva from females contains less protein than that from males, and no correlation exists between body weight and amylase or protein content. The gel electrophoresis identified three major protein groups and six isozymes of amylase in saliva.

*EFFECTS OF MONENSIN SODIUM ON ERYTHROCYTE OSMOTIC FRAGILITY IN DOMESTIC PONIES

Plessman, Pamela J., Seward H.S., Seward, NE 68434
777 E. Pinewood Ave., Seward, NE 68434

The compound monensin sodium is found in cattle feed as an agent which promotes efficiency of feed utilization. It is very toxic to horses, however, and incidences of fatal intoxication have occurred. As an ionophorous antibiotic, monensin has the capability to transport ions across membranes. Since other studies have noted changes in the blood of intoxicated ponies suggesting red cell damage, this study was performed to find out whether monensin caused red cells of the pony to become more fragile. An initial study was done in one pony to see if oral feeding of monensin would result in increased fragility of red cells. This study yielded positive results. A second study was then performed in anesthetized ponies to observe effects of monensin, intravenously, on osmotic fragility of the erythrocytes. Results showed that intravenous monensin acutely increased osmotic fragility of the red cells, and that this change was sustained for a period of two hours. Hemolysis, or breakdown of red blood cells may be a part of the pathophysiology of monensin toxicosis, and may contribute to kidney damage which is known to occur in this condition, and to be a consequence of hemolysis in many different species. It is likely that monensin, by its ion transport effects, promotes the entry of water into red cells, swelling them until physical bursting may occur.

*Third Award - General Motors ISEF

Schistosomiasis is a disease that affects more than 200 million persons around the World. In schistosomiasis that major field of interest by investigators is the development of protective immunity. The development of partial immunity in several experimental hosts has been achieved by many different approaches. The highest levels of protection induced by vaccination are those reported by Hillyer et. al., 1979. Antigens common between S. mansoni and F. hepatica isolated by immunoaffinity chromatography induced 50-81% of protection to S. mansoni in mice.

Few investigators have studied the possibility of utilizing antigens shared berween trematodes and their intermediate hosts in the production of immunity. Kemp et. al., 1982 and Rasmussen et. al., 1984 reported that (denoted Sm W 400-P and Sm W 53-P) were of limited value in serodiagnosis but could be evaluated in immunity to S. mansoni.

The purpose of this research is therefore, 1) to demonstrate the presence of antigens shared between the trematodes S. mansoni and F. hepatica and their respective intermediate snail hosts B. glabrata and Physa cubensis. 2) To isolated by immunoaffinity chromatography this selected group of shared antigens and 3) to test this antigen in the induction of immunity in a murine infection with S. mansoni.

By Ouchterlony ID a serum against B. glabrata hepatopancreas showed 2 lines of precipitation when reacted against a whole S. mansoni worm homogenate. This anti-B. glabrata serum when reacted against a crude homogenate of Physa cubensis showed at least 3 precipitation lines. A serum prepared against P. cubensis whole homogenate when rected with S. mansoni whole worm extract showed 3 lines of precipitation, two of them showing identity with two lines present between anti-Bg and Bg and Bg homogenate. Therefore, we have demonstrated two common antigens between B. glabrata, P. cubensis and S. mansoni worms. The isolation and further testing of these antigens in immunity is currently under way.

#CANCER METASTASIS IN MICE WITH B-16 MELANOMA AND LEWIS LUNG CARCINOMA TREATED WITH BIOLOGICAL RESPONSE MODIFIERS AND DRUG DELIVERY SYSTEM.

Feinerman, Gregg, Miami Country Day School, Miami, Florida 33161
9410 West Broadview Drive, Miami Beach, Florida 33154

The purpose of this investigation was to study the effects of biological response modifiers to stimulate macrophages and natural killer cells on the control of cancer metastasis in C57/BL mice with B16-F10 melanoma and 3-Lewis Lung Carcinoma. A drug delivery system using liposomes to encapsulate a macrophage activator was also used. The effects of macrophages on tissue grown targets was studied. C57/BL mice were given B16-F10 melanoma cells i.v. and then treated 4, 6, 8, 25, 27, and 29 days after tumor implantation with various agents. Control of metastasis to the lungs and survival time was improved with agents that stimulate natural killer cells - murine interferon and C. parvum (periodate oxidation treated). Cyclophosphamide improved survival time. Moderate improvement occurred with ET and liposomal PC; PS; MDP agents that stimulate macrophages. No improvement occurred with 2-LPC and immune lymphocytes. C57/BL mice injected with 3-Lewis Lung Carcinoma cells in the right foot pads and operative procedure was preformed on day 7. Control of metastasis of lungs and improved survival times were noted in mice treated with murine interferon, C. parvum, liposomal PC: PS: MDP and cyclophosphamide. In vitro cytotoxicity of tumor cells by peritoneal exudate cells activated by macrophage agents was studied. The most effective cytotoxicity in vitro of tumor cells P-388 (murine leukemia) was with the use of C. parvum; moderately to liposomal PC: PS: MDP. YAC-1 (lymphoma) cells were sensitive to ET and C. parvum. Biological response modifiers may be effective in controlling cancer metastasis.

#Third Award - General Motors ISEF

THE EFFECTS OF MINOCYCLINE HYDROCHLORIDE IN CRETINISM OF MUS MUSCULUS

Sparks, Pamela A., Nicholas County H.S., Carlisle, KY 40311;
Cliffway Drive, Carlisle, KY 40311

My project involved the effect of the drug, minocycline, on white mice. Minocycline is a tetracycline and can be used to treat a wide range of bacterial diseases. One of the adverse reactions of the drug is a black thyroid. Some authorities believe that black thyroid is caused by minocycline inhibiting iodide peroxidase in the thyroid, degrading it into a black pigment.

I used three groups of just weaned mice in my experiment. The first group was used as controls. The second group of mice received a normal diet and daily doses of a minocycline/sterile water solution, orally. The third group of mice received an iodine-supplemented diet and daily doses of a minocycline/sterile solution orally.

I hypothesized that minocycline would inhibit the iodide peroxidase in the thyroid, degrading it into a black pigment-black thyroid, and that this inhibition would interfere with the biosynthesis of thyroxin, (a growth hormone), producing cretinism. I further hypothesized if provided with an iodine supplemented diet, the cretinism may be deterred.

Stunted length and weight displayed cretinism in the treated mice. The cretinism was less marked in the iodine supplemented treated mice. Dissections of the treated mice showed darkened thyroids. I concluded that minocycline should not be prescribed to infants, children and adolescents in large doses, over an extended period of time. I feel additional research should be conducted to determine precisely how minocin effects the thyroxin and thyroid function.

THE EFFECTS OF YOHIMBINE ON LOCAL ANESTHETIC INDUCED BRAIN SEIZURES

Gorman, Douglas S., Oak Hills High School, Cincinnati, OH 45248; 1412 Devils Backbone Road, Cincinnati, OH 45238.

Of major concern to clinicians at present is the apparent increase in the incidence of brain seizures associated with the use of local anesthetics such as Xylocaine (lidocaine HCl). The purpose of this study was to test the efficacy of yohimbine hydrochloride, an alpha-2 adrenergic receptor antagonist, in suppressing such lidocaine induced brain seizures. This experiment used adult albino Wistar rats. After being anesthetized with halothane, each rat was connected by electrodes to an Electroencephalograph instrument and brain wave activity was monitored. After stable baseline activity was established, each rat received subsequent injections of lidocaine until seizure activity was recognized on the EEG. Following the identification of brain seizures, the effects of different concentrations and dosages of yohimbine were tested.

The data from this experiment readily demonstrates that yohimbine was successful in halting brain seizures. The most effective dose was determined to be 2.0 mg/Kg of body weight, which suppressed seizures as soon as thirteen minutes after such an administration; thereby preventing permanent neurologic damage.

#First Award - American Medical Association

LIPOPROTEINS AS RISK FACTORS IN PERIPHERAL ATHEROSCLEROSIS

Smith, Terri A., Fort Walton Beach H.S., Ft. Walton Bch., Fl. 32548; 217 McArthur Ave., Fort Walton Beach, Fl. 32548.

Atherosclerosis is the disease process that usually results in myocardial infarction which is the principal cause of death in the United States and in most of the western world. One characteristic of atherosclerosis is the deposition of cholesterol in and around cells of the arterial wall. Since the cholesterol that accumulates in the arterial wall is derived from plasma lipoproteins, lipoprotein abnormalities must play an important role in the pathophysiology of both peripheral atherosclerosis and arterial bypass graft failure. Thus, the specific aims of my project are: 1) to determine whether blood lipid subfractions (HDL-C, HDL_2-C, HDL_3-C, and LDL-C levels) can be defined as risk factors in patients with angiographically documented peripheral atherosclerosis, and 2) to examine the role of blood lipid subfractions (HDL-C, HDL_2-C, and LDL-C levels) in the failure of peripheral arterial bypass grafts.

Several tests must be performed on blood samples drawn from some 300 patients divided into four groups. (This is a two year project.) Group I will consist of patients with severe peripheral vascular disease (PVD); Group II will consist of patients with moderate PVD; Group III will consist of patients with coronary artery disease; and Group IV is the control group. The blood samples will be centrifuged and separated into subfractions. The measurements of the cholesterol levels in each subfraction will be recorded and analyzed by Duncan's multiple range test and by the Student's t-Test. The results will be used in identifying a specific lipoprotein as a risk factor for atherosclerosis which would possibly be the first step towards influencing the progression of atherosclerosis by elimination of it from the blood.

#THE EFFECTS OF CAFFEINE ON CHROMOSOMAL MUTATIONS IN DROSOPHILA

Huff, Adam L., Permian H.S., Odessa, Texas 79762;
4345 Springbrook, Odessa, Texas 79762.

Recently, the drug caffeine has been put in a particularly unstable position. Scientists have begun to probe the hazards that this drug might pose to our health. One specific area of concern, which has been linked to caffeine, is the potential for birth defects. Testing has been conducted on laboratory rats and unusually high rates of deformity have been observed in the offspring.

The purpose of this experiment was to determine if caffeine would produce any chromosomal mutations in a balanced lethal stock of fruit flies (Drosophila melanogaster). Four separate tests were conducted with each using four groups of flies, three with varying concentrations of caffeine in their media, and a control group. The dosages ranged from a .25 moles/liter (225020 ppm) solution to a .00012206 moles/liter (110 ppm) solution. The female flies used had one balancer X chromosome and one lethal X chromosome (vermillion-eyed). Male flies had one balancer X chromosome and one Y chromosome. Any chromosomal mutation involving the X factor would result in a higher frequency of death in the male off-spring. Each test group was reared for twenty days and the results were analyzed utilizing the chi-square test for projected offspring.

The data collected in this investigation clearly indicated that caffeine did indeed have genetically altering characteristics in drosophila.

#Fourth Award - General Motors ISEF

CAFFEINE INDUCED HYPERTHERMIA IN RATS

Blankespoor, Curtis L., Holland Christian, Holland, MI 49423;
674 Larkwood, Holland, MI 49423.

Caffeine is a drug commonly found in many substances. It affects the body in various ways. This experiment was conducted to determine (1) whether caffeine causes a change in the body temperature of rats and (2) if changes occur, what specific factors influence the effect of caffeine on these changes. During this experiment, the rats were put into cages and placed in a temperature controlled room. Colonic temperatures were measured by means of a copper-constantan thermocouple covered with a silicon coating inserted 5 cm into the colon and taped to the tail. The temperatures were recorded at one minute intervals on a Honeywell Recorder. After the temperature probes (thermocouples) were in place, the rats were allotted a one-hour adjustment period before temperature recordings were made. Then a base line measurement was recorded for 20 minutes. At the end of this period each rat was injected intraperitoneally (i.p.) with the appropriate dose of caffeine. The temperature recordings continued for 120 minutes, after which the data was fed into a computer. The average change in colonic temperature was calculated in intervals of 5 minutes, beginning 20 minutes before injection and ending 120 minutes after injection. The dose of caffeine and the ambient temperature were found to influence the effect of caffeine on the body temperature in rats. Food deprivation and restrained movement did not significantly influence the effect of caffeine.

THE EVOLUTION OF STAPHYLOCOCCUS EPIDERMIDIS FROM COMMENSAL TO PATHOGEN

Mark Devaraj, Blue Earth High School, Blue Earth, MN 56013;
744 North Main, Blue Earth, MN 56013

Until mid-century Staphylococcus epidermidis, an organism found on human skin, was not known to cause human infection and was susceptible to virtually all known antimicrobial agents. In recent years S.epidermidis has been isolated from infected artificial implants in the body, intravascular catheters and shunts and from debilitated individuals with infections. Resistance to antibiotics, more commonly associated with pathogenic bacteria is now also observed in S.epidermidis strains.

The prevalence and degree of antibiotic resistance of S. epidermidis strains in a group of twenty-four members of the general population and an equal number from a group of hospital workers, are analyzed in the present study. Skin cultures from both groups are studied. Based on cultural characteristics, Gram staining, microscopic examination, catalase and coagulase tests, S.epidermidis colonies are isolated and subjected to antibiotic susceptibility testing. Thirteen antibiotics known to be effective on Gram positive organisms are used and the results compared for the two groups. The most significant results are:

1. The high incidence of Penicillin resistance - 71% in the hospital group and 52% in the community group and
2. Resistance to three or more antibiotics, or multiple resistance (MR) seen in 67% of the hospital strains compared to 21% of the community strains.

Given the extent of the human reservoir for this organism, the spread of strains resistant to multiple antibiotics could pose a major problem, unless indiscriminate use of antibiotics, especially Penicillin, is restricted and new antibiotics developed.

#A MEDICAL ASSAY: THE EFFECTS OF ACYCLOVIR ON IBR INFECTED BOVINE LUNG CELLS

Urdahl, Melanie, Jamestown H.S. Jamestown, North Dakota, 58401
1530 6th Ave. S.W., Jamestown, North Dakota 58401

Antiviral chemotherapy attempts to inhibit viral replication without harm to the host. In recent years, several compounds that inhibit viral replication in infected cells but spare uninfected host cells and their functions have been discovered. The first of these compounds to undergo successful clinical trials against herpes viruses is acyclovir.

My experiment attempted to determine the effects of the antiviral drug acyclovir on bovine lung cells infected with a bovine virus, IBR, IBR was used first because it is a herpes virus and secondly because it is a mammalian DNA virus. Bovine lung cells were used since they are also mammalian and because they are a natural host for the IBR virus.

Bovine lung cells were grown in vitro or in tissue cultures. Cultures were first infected with a 10^{-3} IBR dilution and then inoculated with varying concentrations of acyclovir ranging from 1-500 mcg/ml. After a varying time span, viable and dead cells in each culture were counted using a hemocytometer.

Toxicity tests were also established in which the cells were inoculated with acyclovir only, not IBR. Acyclovir proved to have little or no effect on the viable cell counts. Thus, acyclovir has low toxicity for its host cells.

Mammalian cells and viruses were used in order to relate results to human medical application.

#Second Award - Tissue Culture Association
Third Award - General Motors ISEF

#THE USE OF DMSO AS A SOLVENT VEHICLE IN CHROMOSOME BANDING

Groves, Leonora J., Richwood High School, Richwood, WV 26261; P.O. Box 288, Richwood, WV 26261.

The purpose of this research was to investigate banding techniques in karyotypes and determine if DMSO (dimethyl sulfoxide) could be used as a solvent for standard Giemsa chromosome stain. Chromosomes are karyotyped through differential staining, producing banding, and genetic deformities can be determined. DMSO is a superior solvent and has the ability to penetrate membranes without causing irreversible damage. Thus, the hypothesis of this research was that DMSO would penetrate chromosomes acting as a solvent vehicle for stains to enhance banding in standard karyotypes.

Efficient karyotyping methods were used to produce uniform spreads for investigation of chromosomes. The procedural steps include: withdrawal of peripheral blood, planting peripheral blood, harvesting leukocytes, and preparing slides. Chromosomes were subjected to treatment with .025% trypsin in order to partially digest chromatin material. Determination of the treatment time and optimum concentration of trypsin under standard conditions were critical factors. Effectiveness of an original formula DMSO stain was compared to standard Giemsa staining techniques currently used in cytology labs.

DMSO stains consistently produced darker and more prominent bands than were produced by standard Giemsa. DMSO stain had the added advantage of working within a wide pH range of 6.0 to 9.0. It is likely that this new stain will prove extremely useful in routine human cytogenetics for the recognition of regions of exchange and for identification and analysis of individual chromosomes.

#Third Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

#The Development and Implementation of Four Original Screening Tests For The Identification of Visual Impairments in Elementary School Children

Millard, Amy L., Coral Springs H.S., Coral Springs, Florida 33065; 7603 SW 8 St., N. Lauderdale, Florida, 33068.

The researcher developed four original eye screening tests for use with an Apple II+ microcomputer. Two of the tests dealt with depth perception, one dealt with eye-movement, and one was a memory test. Children, ages six to nine years, with no known visual impairments, were used to standardize the tests. Statistical analysis was applied to the data collected. The scores of children with known visual problems were compared to the mean, and it was concluded that the tests would be accurate as screening devices for children, of that age group with possible eye coordination and focusing problems.

#First Award - Sigma Xi, the Scientific Research Society
First Award - United States Air Force
Second Award - American Optometric Association and Auxiliary to the American Optometric Association
Honorable Mention - American Psychological Association

INCREASED HYPERSENSITIVITY TO AMBROSIA SPECIES RAGWEED IN MUS MUSCULUS DUE TO CROSS-REACTIVITY.

Hodge, Joel L., Sarcoxie High School, Sarcoxie Missouri 64862;
RR#3 Box 90 Carthage Missouri 64836

The principle objective of this experiment is to reveal that Cross-Reactivity among the Ambrosia species ragweeds, Ambrosia bidentata, Ambrosia elatior, Ambrosia-psilostachya, and Ambrosia trifida, plays a key role in the increased hypersensitivity of individuals experiencing Summer and Autumn Allergic rhinitis (Hayfever) due to exposure to the pollen of the Ambrosia species mentioned.

Pollen of the Ambrosia species flora is responsible for the over production of IgE antibodies and histimine in the human immune system, therefore causing the reaction known as Hayfever allergy. The level of this reaction can be increased when an allergic individual is exposed to the pollen of a different species, but, of the same genus, this is known as Cross-Reactivity. Cross-Reactivity can cause reactions as sever as Anaphylaxis in hypersensitive individuals. The level of Cross-Reactivity among the Ambrosia species was determined by the application of intracutaneous skin testing.

Four groups of Mus Musculus were tested using the following procedure:

1. Mice not treated.
2. Mice administerd nasal drops of Ambrosia species mentioned.
3. Mice, administered nasal drops, and skin tested for Cross-Reactivity among the genus.
4. Mice skin tested, but with no prior pollen innoculation.

In a comparison of the reactivity levels among Ambrosia species all showed significant increased sensitivity with Ambrosia bidentata and Ambrosia trifida pollens showing the highest levels of Cross-Reactivity.

#A PILOT STUDY TO DETERMINE THE RELATIONSHIP BETWEEN LEAD CONTENT IN TEETH OF ELEMENTARY AGE SCHOOL CHILDREN IN ALEXANDRIA, VIRGINIA, AND HYPERKINETIC CLASSROOM BEHAVIOR

Peoples, Robin E., T. C. Williams Senior H. S., Alexandria, VA 22302
5341 Truman Avenue, Alexandria, Virginia 22304

Reported are the results of a pilot study to determine if a relationship existed between hyperkinetic classroom behavior and lead accumulations in the body suggesting long-term exposure to high levels in the environment. No such research had previously been conducted in Alexandria.

Deciduous teeth were solicited from children attending five City elementary schools during three months in the Fall of 1983 through an appeal from the "Tooth Fairy." A sample of 112 teeth were donated by children believed to be representative of the elementary school population of the the City. Lead concentrations in 78 teeth were measured using atomic absorption and plasma emission spectroscopy. Three months after the school year began, classroom behavior was rated by teachers of 84 children that donated teeth using a brief forced-choice questionnaire that highlighted hyperkinetic behavior characteristics. Information concerning the location of each child's home, a general assessment of the child's health, and whether the child mouthed hands and other objects was also obtained. Both completed questionnaires and lead concentration measurements were available for only 42 of these students which limited the study to that group.

Lead concentrations determined were correlated with behavior and other questionnaire data. The results obtained suggest a relationship between lead concentrations and hyperactive behavior existed. In addition, dentine lead concentrations in the small sample of children tested were significantly higher than that found in a study with a larger sample conducted in the Boston, Massachusetts, area during the mid-1970s.

#Fourth Award - General Motors ISEF

TRANSFORMATION OF THE GLUCOCORTICOID RECEPTOR TO THE DNA BINDING FORM

Pratt, Sean E., Pioneer H.S., Ann Arbor, MI 48103
1612 Granger, Ann Arbor, MI 48104

Glucocorticoid steroids are used to treat a wide variety of diseases. They cause their effects by binding to a specific receptor located in the cytoplasm and the steroid-receptor unit is then transformed to a form that binds to DNA and causes the synthesis of mRNA. The mechanism of this transformation is unknown. It is clear that transformation is temperature-dependent, suggesting that an enzyme is required. The purpose of this project is to see if there is a transforming enzyme. Cytosol was prepared from the livers of adrenalectomized rats and the steroid receptor was identified by its ability to bind (^{3}H)triamcinolone acetonide in a manner that is blocked by a high concentration of non-radioactive dexamethasone. The (^{3}H)triamcinolone acetonide-receptor unit was separated from a potential transforming enzyme by filtering it through a column of Biogel A.5M. Unlike the unpurified receptor, the Biogel purified receptor is no longer transformed to the DNA binding form when it is incubated at 20°C. The DNA binding form is assayed by its ability to bind to DNA-cellulose. The Biogel purified receptor can be transformed by ammonium sulfate at 0°C, showing that it can be transformed by other methods but not in the usual manner by temperature. If a fraction of cytosol containing components larger that 10,000 daltons is added back to the Biogel purified steroid-receptor unit, the receptor will transform when the mixture is incubated at 20°C. This project provides evidence that an enzyme directs this critical reaction which is required for the hormone effect.

ELIMINATION DIET VERSUS RITALIN IN THE TREATMENT OF HYPERKINESES IN MUS MUSCULUS

Stone, Karla A., Lutcher H.S., Lutcher, LA 70071
221 N. Ezidore Ave., Gramercy, LA 70052

The purpose of this project was to test the best method of treatment for hyperactivity in Mus musculus, elimination diet or Ritalin.

All mice were allowed to adjust to their environment for a period of one week. The mice were weighed and placed on a counter wheel to obtain their normal average. Hyperactivity was induced by placing the variables on a diet consisting of artificial food colors and flavors. The variables were again weighed and placed on a counter wheel to obtain their new average. Although all of the variables were placed on the same additive induced diet, the dosage was figured out with the help of a doctor, and Group II mice were injected with Ritalin. Group III mice were gradually taken off of the additive induced diet and placed on an elimination diet, having all artificial food colors and flavors eliminated. Variables were observed to be in an extremely nervous state after four weeks on the additive induced diet. There was a noticeable increase in counter wheel revolutions as compared to the first week.

Ritalin injected variables showed signs of calmness on the first day and by the fourth day appeared to be in a drugged state. There was a decrease in counter wheel revolutions and also in weight. By the next morning after each shot, the mice had returned to their irritable state. Over a five-day period the behavior of Group III gradually returned to normal; all symptoms of hyperactivity had diminished.

Thus, tests prove that it is better to treat Hyperkinesis by an elimination diet rather than Ritalin and its undesirable side effects.

THE EFFECTS OF SMOKING ON THE HEALTH OF MAMMALS

Simon, Stephen G., Lincoln Senior High School, Sioux Falls, South Dakota 57105;
2712 Bragstad Drive,
Sioux Falls, South Dakota 57103

The purpose of this experiment was to show the effects of smoking on health. Also, for the reader's benefit, if he should be a smoker, to make him consider the results, and hopefully drop the habit. The procedure I used was as follows: keep ten tan male mice from eating for a day. At the end of that day, find the distance they could travel on an exercise wheel in one minute by placing food in front of the wheel. Test the respiration rate of each mouse in a small animal respiration chamber. Do this procedure for three days to obtain an average distance and an average rate before experimenting. Do this same procedure for ten more days, but expose five of the mice to cigarette smoke throughout each of the ten days. Send lung and trachea tissue to Dr. James E. Collins, DVM, for histologic testing. The results of my experiment show that smoking decreases one's physical output abilities and increases one's respiration rate, and thus shows that smoking influences one's respiration and endurance. In evaluating my research plan, one weakness I found was that after one entire day without food a mouse becomes quite disoriented, and his sense of smell does not work at its regular capacity. Also, since I only tested the mice for ten days, there were no histologic differences.

SYNERGISM IDENTIFICATION OF ANTIBIOTIC COMBINATIONS USING SENSITIVITY TESTING TECHNIQUES

Atkins, Tonette June, Paoli H.S., Paoli, IN 47454
214 Virginia Ave., Paoli, Indiana 47454

Since 1929 when penicillin was discovered, antibiotics have become increasingly popular. They are at times prescribed indiscriminately. This "shotgun therapy" has decreased the ability of single antibiotics to control microorganisms and caused resistant strains to develop. The purpose of this project was to determine if specific combinations are more effective in the control of selected organisms than single antibiotics.

Erythromycin, penicillin, neomycin, tetracycline, lincomycin and chloromycetin were used for desired combinations. Phase I consisted of a disk sensitivity testing in which disks of each antibiotic and 15 combinations were placed on innoculated agar plates. E. coli, S. aureus, A. aerogenes and B. subtilis were used to innoculate the plates. These plates were incubated and zones of inhibition were observed. Phase II consisted of a tube dilution technique. The MIC was determined by a Bausch and Lomb Spec 20. Percent transmittance was read and recorded for each combination and single antibiotic. Data was then analyzed.

Based on the obtained data, the following conclusions were made: 1) Lincomycin does not combine synergistically with other antibiotics; 2) tetracycline combinations are the most effective in controlling the test organisms; and 3) overall, combinations of the antibiotics are more effective.

AN INTRASPECIES AND INTERSPECIES COMPARISON OF CIRCADIAN RHYTHMS IN BLOOD GLUCOSE LEVELS - ASSAYS OF NORMAL, HYPERGLYCEMIC, AND DIABETIC SUBJECTS

Lamperez, Alfred J., Catholic High School, New Iberia, LA 70560
506 West Main Street, New Iberia, LA 70560

The purpose of this project is fourfold: 1) To measure patterns in blood glucose levels of various species (pigeons, mice, humans), and to investigate intraspecies relationships; 2) To determine the interspecies similarities or differences in such patterns; 3) To compare the circadian rhythms of normal, hyperglycemic, and diabetic subjects; and 4) To study changes in the patterns at the onset of diabetes. The methodology involved monitoring blood glucose levels four times per day for normal pigeons and mice, as well as normal and diabetic humans. In addition, several mice were given Streptozotocin doses (200mg/kg body weight) to chemically induce hyperglycemia and Type I diabetes. Diabetic mice were treated with insulin. Glucose levels were measured for both groups of experimental mice four times each day. Each species studied possesses a circadian rhythm in blood glucose levels. Furthermore, a relationship does seem apparent between mouse and human blood glucose levels. The occurrence of diabetes in both studies also reveals significant changes. It appears that detailed investigations of circadian rhythms in blood glucose levels in mice could be accurately applied to humans, particularly as an alternate screening method for diabetes.

#STUDIES ON GOSSYPOL: II. ANTIFERTILITY EFFECTS IN NUTRITIONALLY DEPRIVED MALE HAMSTERS

Baker, Loretta M., East Noble High School, Kendallville, IN 46755
430 W. Williams St., Kendallville, IN 46755

This research was designed to determine the antifertility effects of gossypol on nutritionally deprived male hamsters and their offspring. Fifty male hamsters were divided into four groups. Group 1 served as controls. Group 2 received 20 mg/kg of gossypol intraesophageally + a normal diet for six weeks. Group 3 received no gossypol + an 8% low protein diet. Group 4 received 20 mg/kg of gossypol + an 8% low protein diet. After four weeks, half of the males were mated while gossypol dosing continued. At six weeks, half of the males were sacrificed and sperm counts, motility, and histological sections were done. Reversibility studies were conducted on the remaining males.

Sperm counts were reduced 97.7% in group 2 and 99.5% in group 4 at six weeks; this was highly significant using a student t test ($P=0.001$). Six weeks after gossypol doses were terminated, groups 2 and 4 exhibited 35% and 33.4% reduction in sperm counts. At eight weeks, these were further reduced to 18.5% and 20.7%. Gossypol groups 2 and 4 exhibited a reduction in sperm motility of 63.3% and 74.4% respectively at six weeks; this was also highly significant ($P=0.001$). In reversibility studies, sperm motility was only 8.7% less than the controls for group 2 and 11.1% less than the controls for group 4. No litters were born from matings of gossypol treated males. Blinded studies of six week histological sections revealed testicular necrosis and degeneration, severe reduction in spermatids and spermatozoan numbers in groups 2 and 4. It was concluded that 20 mg/kg of gossypol serves as a most effective antifertility agent in male hamsters. Physiological effects of gossypol are reversible, even in nutritionally deprived animals. Therefore, gossypol could be the ultimate answer to world population control.

#First Award - American Veterinary Medical Association
Scholarship - Miami University
Scholarship - University of Toledo
Second Award - General Motors ISEF

#THE EFFECT OF TUMOR CELL INOCULATION ON THE IN VIVO AND IN VITRO GENERATION OF CYTOTOXIC T LYMPHOCYTES

Sousa, Jamie Marie, Our Lady of Fatima H.S., Warren, R.I. 02885,
41 Canario Dr., Warren, R.I. 02885.

The purpose was to test the effect of leukemic mouse serum (LMS) on the group of lymphocytes, cytotoxic T lymphocytes (CTL), that are responsible for tumor killing. I developed a new system to generate anti-tumor killing. AKR and C3H strains of mice were injected with BW5147 leukemic cells treated with mitomycin C. At various times after immunization, spleens were harvested and a single cell suspension of spleen cells were used to establish mixed lymphocyte cultures (MIC). These cells were added to tissue culture wells at a concentration of $9x10^6$ cells/well. In addition, BW5147 cells, treated with mitomycin C, were added at various concentrations, (.25 - $2x10^6$ cells/well) in order to determine the optimal responder/stimulator ratio. Cultures were then incubated at 37° C in a 5% CO_2 incubator for 5 days. CTL activity was measured by harvesting the viable cells and incubating them with several different concentrations of ^{51}Cr - labeled BW5147 tumor cells. After a 4 hour incubation at 37°C the supernate from the tubes containing ^{51}Cr BW cells were counted in a gamma counter to determine the amount of ^{51}Cr released into medium. To test the effect of LMS on CTL generation, LMS was added to the cultures containing spleen cells and tumor BW5147 cells at the beginning of the 5 day incubation period.

These studies showed time of immunization may play a critical role in generation of CTL and cells responsible for destroying tumor cells in vitro are suppressed by the presence of LMS in the serum.

#Third Award - General Motors ISEF
Honorable Mention - United States Army

#ARE BLIND SPOTS EQUAL IN SIZE?

Lemley, Jane E., Washington-Lee H.S., Arlington, VA 22201;
2724 N. 18th St., Arlington, VA 22201.

The purpose of this paper was to prove that right-handedness and left-handedness affect the size of the female's left and right blind spots. Nine left-handed and nine right-handed females between the ages of fifteen and seventeen and the heights of five feet and five feet seven inches were tested. Each sat facing an eye level fixation point on a sheet of graph paper while resting their head on a desk. The left eye was covered with the right eye concentrating on the fixation point, and the subject identified whether she could see the "wand" or pencilled dots. The blind spot was graphed from a general to exact location. The procedure was repeated, but with the right eye covered and the concentration focused to the left of the fixation point. The average length and width of the left and right blind spot of the left-handed females was taken and compared with that of the right-handed females. In left-handed females, the left blind spot is greater in length and width than the right blind spot. In right-handed females, the right blind spot is greater in length and width than the left blind spot. From these results, it can be concluded that hand dominancy does affect the size of the female's left and right blind spots.

#Honorable Mention - American Psychological Association

MICROBIOLOGY

THE EFFECTS OF MICROWAVE RADIATION ON CO_2 PRODUCTION BY YEAST

Bolterman, Gregory J., Central High School
Davenport, IA 52803
2322 Ripley Street, Davenport, IA 52803

My research dealt with the effects of microwave radiation on CO_2 production by yeast. The results of the experimentation showed that yeast have an optimum microwave exposure level of four seconds per day. The rate of CO_2 production rises gradually as the duration of radiation increases until it reaches four seconds per day. At exposure times of over four seconds, the rate of CO_2 production drops sharply until at sixteen seconds per day the rate of CO_2 production is nearly zero.

Follow up experimentation involved baking bread using irradiated yeast and comparing it with bread baked with normal yeast. The loaves showed absolutely no difference in taste, color, texture or smell.

Future research will involve testing the cost effectiveness of implementing this procedure in large industries such as food processing.

#Fourth Award - General Motors ISEF

#BACTERIA IN RAW MILK

Van Beek, Shannon D., Pollock High School, Pollock,SD 57648
R.R. Box 13, Strasburg,ND 58573

Raw milk contains several types of bacteria, such as: the Coliform bacteria, Staphlococcus bacteria, and Streptococcus bacteria.

The procedure that was used involved inoculatingwith raw milk three special agar mediums. Those used were: Mannitol Salt Agar, Hektonen Enteric Agar, and Violet Red Bile Agar. After inoculation, the mediums were incubated at 25 - 37 degrees Celcius, in a dark area at ninety per cent humidity. Slides were then prepared by Graham's staining method using Crystal Violet stain to determine if these bacteria were present. Research was also done to determine if there was a change in the amount of bacterial growth with the changes in the seasons, for example: during the month of April, Farmer X had bacterial counts of between 500,000 and 600,000 and in the month of November, the same farmer had bacterial counts of between 79,000 and 110,000.

It was found that the seasons of the year affect the rate of bacterial growth. Not all of the bacteria in raw milk is harmful.

#Alternate to London International Youth Science Fortnight - United States Marine Corps

#IMMUNITY TO HERPES SIMPLEX VIRUS 1 CONFERRED BY GENETICALLY-RESTRICTED VARIANTS AND IMMUNOACTIVATING FACTORS

Thrailkill, Timothy A. Melbourne High School, Melbourne, FL 32901
668 Oakridge Drive, Indialantic, FL 32903

Active immunity to herpes simplex virus 1 has been conferred with the use of an experimentally effective live vaccine. Vaccine samples were comprised of inductor-exposed variants of parental H166^{+} in aerosolized form for oral inhalation. Variant populations were assured of monostrain purity by monoclonal antibody selections. Variants were screened for in vitro avirulence, in vivo apathogenicity, antigenicity, and immunogenicity. A prototypical vaccine affirmed sufficient attenuation and a potentiated vaccine confirmed immunogenic potential. Studies of nodal infectivity indicate primary replication in the oral cavity, with associated neural invasion, and secondary replication in splenic and hepatic tissues. Proposed genotypes based on phenotypic data gave insight as to mechanisms of the abortive viral infection.

Final vaccine experiments explored immunizing regimens. Immunogenicity indices were designed on nomographs. Protocols on murine subjects resulted in full protection versus primary infection and effective protection versus latent recurrence. Protection versus latency was by 1:1 cellular colonization in the trigeminal ganglia. Immunity was polytypic in nature in respect to other HSV-1 strains. Potentiated Cai 166 samples were safe in immunocompromised mice. Rabbit testing demonstrated the effectiveness of the vaccine. Overall results support the hypothesis that this vaccine is ready for human subject trials.

Recent studies indicate nontransmissibility of variants from vaccinated to unvaccinated individuals, probably due to reduced chance of morbid recrudescence by variants. Communal efficacy of the PL166' vaccine was proven resistant to acquiring contagious infection. Future research involving occult latency is in progress.

#First Award - General Motors ISEF
First Award - Glenn T. Seaborg Nobel Prize Visit
First Award - Patent and Trademark Office/U.S. Department of Commerce/Patent Office Society
First Award - Sigma Xi, the Scientific Research Society
First Award - United States Air Force
Scholarship - Ohio State University
Honorable Mention - American Society for Microbiology
Honorable Mention - United States Army

THE EFFECT OF MONOSACCHARIDES, DISACCHARIDES, AND A SUGAR SUBSTITUTE ON THE GROWTH AND ACID PRODUCTION OF STREPTOCOCCUS MUTANS

Vance, Victoria, Coral Springs H.S., Coral Springs, FL 33065;
7516 NW 43 Court, Coral Springs, FL 33065

In this experiment a correlation between the type and concentration of sugar or sugar substitute and the possibility of subsequent dental caries was explored. Dental caries is believed to be a result of the action of bacteria on sugar which results in acid production. The acid formed damages the teeth until it is washed away by saliva or by the brushing of the teeth. Brain-heart infusion broths with different types and concentrations of sugars and one sugar substitute were inoculated with the caries causing bacteria Streptococcus mutans. It was found that the concentration of sugar had an inverse relationship to the growth of the bacteria; however, it had little affect on the increase in acidity. It was discovered that the disaccharides sucrose and lactose caused greater growth of the bacterial colony than did the monosaccharides dextrose and fructose; although all of the natural sugars reached the same level of acidity with the exception of fructose, which had a slightly lower acid level. The sugar substitute saccharin permitted neither growth of the colony nor an increase in acidity. Finally, it was found that the best time to brush the teeth was immediately after eating or no later than three hours after eating in order to remove acid and its source before the acid level becomes high enough to encourage cavity formation.

#THE CHARACTERIZATION OF A CONJUGATIVE R-PLASMID FOUND IN A NEWLY-ISOLATED WILD-TYPE OF ESCHERICHIA COLI

Chew, Albert Fook M., Carl Junction H.S., Carl Junction, MO 64834
106 Rocky Lane, Carl Junction, MO 64834

R-plasmids are a group of conjugative plasmids carrying resistance genes to certain antibiotics, heavy metal ions, and other antibacterial agents. The selection for R-plasmids by drug therapy, together with their interspecific transfer creates an increasing threat to the treatment of bacterial infections.

In the research, an R-plasmid housed by HT-99, a new wild-type isolate of the coliform Escherichia coli from sewage-contaminated waters in Ireland, was characterized. A conjugational transfer system was established where the $R+Cml^r$ plasmid was transmitted from E. coli HT-99 ($Lac+Rif^s$) to E. coli J-53R ($R-Lac+Rif^r Cml^s$). In turn, the recipient underwent binary fission yielding transconjugants ($R+Lac+Rif^r Cml^r$). The transconjugants in addition to their parents were then subjected to antibiotic susceptibility testings, biochemical studies, and heavy metal-resistance screenings.

Experimental data indicated an erythromycin-resistant gene and a zinc-resistant gene in addition to the chloramphenicol-resistant determinant on HT-99's plasmid. A major application of the research is that it demonstrates the great importance that bacteria housing R-plasmids have in creating new drug-resistant strains due to the excessive use of drugs in our society. Further research will include investigating the R-plasmid's incompatibility group and the possible existence of the drug-resistance genes on transposons. Moreover, the potential of HT-99's R-plasmid in the Ames Salmonella/microsome carcinogen detecting system and its possible thermosensitivity and colicinogenicity will be investigated.

#First Award - United States Army
Second Award - United States Air Force
Third Award - General Motors ISEF
Honorable Mention - American Society for Microbiology

GENETIC RECOMBINATION THROUGH CONJUGATION

Hruska, Laura L., Jamestown, H.S. Jamestown, North Dakota 58401
101 Holiday Park Village, Jamestown, North Dakota 58401

Conjugation is a means of transferring genetic information from one bacterium to another.

I used three donors to perform conjugation experiments; E.coli Ht-99, E. coli 11H, and E.coli Sm10 which contains a transposon. The recipients in my experiments were E.coli J-53R and E.coli K-12NE. The antibiotics used were chloramphenicol and rifampin in the E.coli Ht-99 and E.coli J-53R trials.

The recipient cells were heated at 45-50°C for 10 minutes. The donor cells were kept at 37°C. The cells were mixed at a 1:9 ratio of donor cells to recipient cells in 5 mls of broth. The culture was incubated for seven or 24 hours. The culture was then diluted to 10^{-7}, then the 10^{-5}, 10^{-6} and 10^{-7} dilutions and plated on a TSA plate containing both antibiotics. The donor and recipient cultures were plated on TSA plates containing one of the antibiotics.

The results confirmed that the bacteria were resistant and sensitive to the proper antibiotics. The combination plates indicated that the resistance genes can be transferred. The E.coli Sm10 and E.coli K-12NE transferred resistance at a ratio of 9.26 recipient cell/recombinant cell from the 5th dilution, 9.935 recipient cells per recombinant cell from the 6th dilution.

These results indicate that conjugation is an effective means to transfer antibiotic resistance genes.

ARE GROWTH INHIBITORS PRESENT I'I PECAN HUSKS?

Bonnette, Kerry J., Simmesport H.S., Simmesport, La. 71369
Rte. 1, Box 989, Simmesport, LA. 71369

ARE GROWTH INHIBITORS PRESENT IN PECAN HUSKS?

The reason for this project is to discover if there are any substances present in pecan husks that would prevent the growth of bacteria in the soil, suggesting medicinal value.

Nutrient agar plates were innoculated with six types of bacteria: Aspergillus niger, Bacillus cereus, Micrococus luteus, Serratia marcessens, Sporacina urea, Streptomycetes griseus. Sterile filter paper disks were saturated in the juices of the pecan husks and placed on innoculated dishes. This test was performed using green and dry pecan husks. Five tests were performed, two tests with green husks and two tests with dry husks, and one served as a control.

Another test was performed to test the effects of green husks and dry husks on the germination of Red Comet radish seeds. Five grams of husks were mixed with ten grams of water, with the same dilution as previously used, and placed in a petri dish. This test was performed with green and dry pecan husks. One dish was filled with the distilled water to serve as the control.

After completion of these tests the following conclusions were formulated. There are bacterial growth inhibitors present in green pecan husks. The growth inhibitors that were present in green pecan husks were absent in dry husks. Green pecan husks prolonged germination of Red Comet radish seeds, while dry husks slowed the germination rate.

#MICROBIOLOGICAL,CHEMICAL AND STATISTICAL STUDIES OF VARIOUS FUNGIS SPECIES ACTING AS BIOLOGICAL CONTROL "IN VITRO" AND "IN VIVO" FOR PHYTOPETHORA INFESTANS

Román Iriarry,Elsa -Dr. Pila Senior High School
Ponce,P.R.00731
Reparto el Valle Calle A # 7 A Magueyes Ponce, P.R. 00731

The purpose of this investigation is to test in microbiologically, chemically and statistically the capacity that various fungis species "in vitro" and "in vivo" have to control the P.infestans, pathogenic mold that causes the late blight in tomato and potato crops.During the first phase of this study various fungis species were selected and identified with them,various biological fights "in vitro" and "in vivo" were prepared.With the same objective extracts of the antagonist mold were prepared too,to make the susceptibility tests.To analyse the results of the test we used the Analysis of Variance (ANOVA) and the Duncan's New Multiple Range Test to demonstrate statistically that the results that we obtained of both tests were not be a random,but the antagonist affect significantly and adversely the growth of P.infestans.Based on the results of the first phase of this research work several conclusions can be made that T.viride,A.niger and P.lilaceum induce a signi - ficanse different greater than P.citricum. During the second phase of this investigation we prepare test of antagonic and pathogenicity with the molds that demonstrate the capacity to control P.infestans "in vitro". After 14 days of observations we continued writing data of the plants during 8 weeks.These observations revealed that T.viride,P.lilaceum and A.niger have the capacity to control the pathogenic "in vivo" meanwhile P.citricum doesn't have this capacity. The third phase of this study consist in the identification of the sustance that can be use as growth inhibitors for P.infestans,but the results are in process.

#First Award - Eastman Kodak Company
Fourth Award - American Phytopathological Society
Fourth Award - General Motors ISEF
Alternate to Scholarship - Ohio State University

DETERMINATION OF THE ACTIVE CONTRACTILE SITE IN AMOEBAE

Kreutter, Kevin D., Meade Senior High School, Ft. Meade, Md. 20755
HQ FORSCOM, ATTN: AFOP - FM, Maj. Dale Kreutter,
Ft. McPherson, Ga. 30330

My project attempts to discover several physical properties of the active contractile site in Chaos carolinensis and Amoeba proteus. This contraction site is believed to cause amoeboid movement (Park, 1981). I plan to determine the site's a) similarity or difference in the two amoeba species; b) location within the amoebae; c) size; d) relative or absolute size properties; and e) type of contraction.

Cell fragments of different size were cut from different regions of Chaos and Amoeba. The cutting operations were performed free-hand with microneedles. Each amoeba fragment was observed for one hour following vivisection. Notes were taken each minute on the length changes and on the amoeboid movement of the fragments. These two criteria were used to answer my five objectives.

The sixteen experiments performed indicate that 1) the active contractile sites of the two amoeba species are significantly different; 2) the sites are located in the posterior and the mid-region of both Chaos and Amoeba; 3) the site occupies three-fourths of the cytoplasm in Chaos. The size is not known for Amoeba; 4) the size of the active contractile sites cannot be considered relative or absolute in Chaos and Amoeba because the sites are distinctly different; and 5) Amoeba exerts isotonic pressure in the posterior and isometric pressure in the mid-region. The nature of contraction in Chaos is not known.

My work supports and elaborates on the contraction-hydraulic theory of amoeboid movement (Mast, 1926; Jahn, 1964); it opposes the frontal-contraction theory (Allen, 1961).

The Effect of Splenectomy On Suppressor T-Cells

Pilkerton, Raymond A., Gonzaga College H.S., Washington D.C.
15111 River Rd., Potomac,Md. 20854

This project was done to give support to a hypothesis arrived at by an earlier project. The hypothesis was that the reason that there were two types of responses to an injected antigen (attenuated tubercle bacillus) was because of the drainage.

Earlier rabbits were injected with the antigen in the ear, sub-conjuntiva, and the anterior chamber of the eye. In the ear and the sub-conjunctiva there was a classic type 4 hypersensitivity response, whereas in the anterior chamber there was a suppressed response. It was hypothesized that this difference was because of the fact that the anterior chamber drains into the venous system, and into the spleen where suppressor T-Cells are manufactured, while both the ear and the subconjunctiva drain into the lymph system,where helper T-Cells are manufactured.

This project helped to give support to the hypothesis as we injected both splenectomized and non-splenectomized rats. It was found that in the rat with the spleens left in tact the same response that we acheived last year was found, whereas in the splenectomized rats a type 4 delayed hypersensitivity response was found supporting our hypothesis.

THE HIDDEN ASSASSINS: A NEW NATURAL ANTIBIOTIC FOUND IN THE ROOTS AND HEARTWOOD OF THE OSAGE ORANGE TREE AS A FOOD PRESERVATIVE

Dukes, Cedric Delander, Marshall County Senior High School
Lewisburg, TN 37091
1901 Phillips Street, Lewisburg, TN 37091

The main objective of this study is to investigate the possible antimicrobial effect of organic extractions from the roots and heartwood of the Osage orange tree, as a food preservative. An antimicrobic is a chemical that kills or inhibits the growth of microorganisms. Through all the research, we had developed a worry about the regulation of FDA over Sodium Nitrate ($NaNO_3$), on commercially processed meats and food products.

In this project, the idea was to reaffirm that antibiotics in their natural forms can inhibit the growth of bacteria. All bacteria and fungi were transferred to test tubes and petri plates using standard inoculation procedures. All plates were incubated at $37^{o}C$. The inhibitory effect was determined on the basis of the size of an inhibition zone measured with a colony counter. Fresh pieces of hams, luncheon meats, sausages, filled pastries and fresh vegetables were injected with a dose of the Osage orange preservative, equivalent to 30% of their weight (10.0 gr.). By each sample there was a piece of food product for every hour that a turbidimetery determination was done. The acetone layer of the Osage orange had the largest preserving time up to 72 hours.

My conclusion indicates that the roots and the heartwood of the Osage orange tree will successfully produce antibiotic and inhibit the growth of pathogenic bacteria. It is an effectively preservative for meats and many other products. This leads to the possibility of being used as a substitute for Sodium Nitrate ($NaNO_3$), the HIDDEN ASSASSINS.

FECAL DEFILEMENT: WHO'S THE CULPRIT?

Gedris, Michael C., Central Davis Jr.H.S., Layton, Utah 84041;
2854 East 2700 North, Layton, Utah 84041.

For my project, I decided to determine what types of animals were polluting the water in the creeks and streams near my home, and to stress why it is so important to take care of our precious water.

I used the Membrane Filter Technic to test five water sources for each of the following indicators of fecal contamination: Coliform Bacteria; Fecal Coliform Bacteria; and Fecal Streptococci Bacteria.

In the Membrane Filter Procedure, a sterile filter is placed upon a receptacle bearing a porous plate, and the polluted water is vacuumed through it.

The bacteria that was in the water is now trapped in the filter, and this filter is placed on the appropriate growth medium; according to the type of bacteria for which I am testing. The fecal strep's and the coliform totals are both incubated at 35 degrees Celsius. The fecal streptococcus must grow for 48 hours, while the coliform totals need only grow for 24 hours. The fecal coliforms must, on the other hand, be placed in a water-tight container and put in a water-bath for 24 hours. These samples should remain at 44.5 degrees Celsius; plus or minus two tenths of a degree.

After the growth period ends, the petri dishes containing the filters are placed under a microscope and the colonies are counted. By figuring the ratio of the fecal coliforms to the fecal strep's I can determine what polluted the water. (A ratio of 1:4.4, (One strep to 4.4 coliforms), denotes human feces. A .6 shows a duck, etc..)

I found that humans caused the majority of the defilement. This shows that we must be very careful with our water. It is better to stop contamination now, than to be forced to take drastic steps later.

#SCREENING OF THE ANTIBACTERIAL PROPERTIES OF SOME TROPICAL PLANTS EXTRACTS WITH SPRCIAL ETTENTION TO THE SPECIES PUNICA GRANATUM

Melendez, Peter A., Colegio San Antonio, Isabela, P.R. 00662;
Ensache Gonzalez #87, Isabela,P.R. 00662.

This investigation represents an attempt to study the possible inhibitory effect of 200 tropical plants of the northwestern region of P.R. over 18 Species of gram-positive and gram-negative bacterias.Methanolic leaf extracts of some positive plants were also tested.

Standard methods of inoculatin were used.All bacterias were cultured in nutrient agar and nutrient broth.M.H.A. was used for the tests. Sensivity tests were carried out using the Kirby-Bauer Method.The antibacterial effect was determined on the basis of the diameter of the inhibition ring in m.m.Extracts were applied using Difco Concentration Disks.Proper controls of a nutrient agar plate,agar plate with disks, agar plate with disks contaning extracts but no bacteria,and bacterial cultures without either extracts or disks were used.Most plates were incubated at 37 C.Comparison of positives extracts with known antibiotics was also carried out.

Of all 200 plants,15 gave positives results.These were:P. granatum (f) over 15 bacterias,C. aurantifolia(f) over 16,C. aurantium(f) over 17,P. acidus(f) over16,R. officinalis(1)over 11 bacterias,M. bijuga(1) over 8,C. cujete(1) over 11,P. dominguensis(1) over 10,T. cattapa(1) over 7,C. hirta(1) over 9,U. lobata(1) over 5, L. speciosa(1) over 4, T. indica(1) over 12 bacterias, Undetermined #1,#2 over 8 and 9 bacterias respectively.

P. granatum was chosen to carry out an attempt to separate and identificate the active components responsible for the inhibitory action.T.L.C. and Column Chromathography were used.The Column Chromatography reveled at the fraction 1-10 and 11-50 the presence of active components.T.L.C. of this fraction demostratd the presence of three components.Work continues in other methods for separation and identification

#Second Award - General Motors ISEF

BIOSURFACTANT-PRODUCING BACILLUS LICHENIFORMIS POTENTIALLY USEFUL FOR ENHANCED OIL RECOVERY

Kim , Yon Hui S., Moore H.S., Moore , OK 73160
300 N. Eastern Moore Ok
73160

Petroleum sulfonates are currently the most commonly used surfactants of enhanced oil recovery (EOR). This surfactant can reduce the interfacial tension to 0.001 mN/m, between oil and brine. But there are drawbacks because of the expense of synthesizing the co-surfactants. Many microorganisms produce biosurfactants with the advantage of being produced from inexpensive materials. Bacillus licheniformis has been isolated from oil field injection water. B. licheniformis produces a biosurfactant when grown at 40°C in a sucrose mineral salts medium containing 5% sodium chloride.

This research was conducted to test the effectivness of the biosurfactant by injecting the surfactant with bacteria cells and an extract without bacteria cells through sand columns and Brea sandstone cores. The results of the experiment shows that it is beneficial to use biosurfactant from B. licheniformis in oil displacement, but the percentage of recovery could be higher if the surfactant's interfacial tension could be lowered. The benefits may be that as biosurfactants become more efficient than using synthesized co-surfactants, the expenses would become more economical.

#First Award - Gulf Oil Corporation
First Award - U.S. Department of Energy
Second Award - American Association of Petroleum Geologists
Fourth Award - General Motors ISEF

PHOTOPERIOD AS A FACTOR FOR CONTROLLING THE SEX IN DAPHNIA MAGNA

Uharriet, Jennifer, Davis H.S., Kaysville, Ut 84037;
718 S. Grand Oaks, Fruit Heights, Ut 84037

The problem was to determine if photoperiod was a factor responsible for the induction of male Daphnia. And if so, in which photoperiod the percentage of males was greatest.

Daphnia produce parthenogenetically (i.e., without fertilization), and cultures normally consist of only females, but adverse conditions cause them to produce male Daphnia.

Hypothesis one was that varying photoperiods, the relative lengths of alternating periods of lightness and darkness, would induce production of male Daphnia. Hypothesis two was the longer the Daphnia were subjected to the light the greater the percentage of males.

Fifteen vials were set up. Each contained three female Daphnia. Three vials were placed in total darkness, three in six hours of light per day, three in twelve hours of light, three in eighteen hours of light and three in twenty-four hours of light. The ambient temperature of the room in which the cultures were maintained was 70 degrees. The young produced were allowed to mature for six days before they were sexed.

It was observed male Daphnia were induced into all the populations.

The first hypothesis was correct in that varying photoperiods induced production of male Daphnia. The second hypothesis was incorrect. It was not true that the longer the Daphnia were subjected to the light, there would be a greater percentage of males. Group 2 which received six hours of light per day produced the greatest percentage of males, an average of 75.85% males.

Daphnia (water fleas) are the basic food of many fish and are therefore considered economically significant.

#STAPHYLOCOCCUS: FACTORS INFLUENCING ITS GROWTH ON THE SKIN

Cox, Jennifer, Medical Lake High School, Medical Lake, WA 99022
Rt. 1, Box 47, Medical Lake, WA 99022

Staphylococcus bacteria are natural inhabitants of the human body and may be easily isolated from the skin. There are generally two major species of Staphylococcus that are found: Staph aureus and Staph albus. Each individual person is host to at least one of these species. The conditions which enhance or prohibit the growth of one of the species is unknown. There may be many factors that influence the particular species a person hosts.

The purpose of this project was to determine the factors that are similar among those hosting the same species of Staphylococcus bacteria. To do this, it was necessary to take a wide sampling of people. Approximately 200 people were eventually used in the study. Each person was asked to fill out a questionnaire to determine their diet, activities, diseases, medications, etc. Pulse, blood pressure and pH of the skin were also taken along with a swabbing of their forearm. The swabbing was then placed onto a plate of mannitol salt agar, a medium that aids in the selection and differentiation of Staphylococcus species. The final results showed that factors such as gender, age, whether a person smokes, amount of physical activity, salt consumption, and amount of stress all showed a pattern. Many other factors were also tested, some of which showed variable patterns. This study exhibits several correlations between S. aureus, S. albus and their hosts.

#Fourth Award - General Motors ISEF

#BACTERIAL CONJUGATION: A MEANS OF TRANSFERRING ANTIBIOTIC RESISTANCE

Redding, Rebecca Ellen, Emerson Jr. H.S., Enid, OK 73701
1509 Ponca, Enid, OK 73701

The purpose of my experiments was to investigate bacterial conjugation as a means of transferring penicillin resistance, as well as nutritional factors from one strain of E. coli to another.

Two strains of E. coli were used in my experiments: ATCC 23590 K-12 F+, to be used as a donor and ATCC 23724 K-12 F- which would act as the recipient. Contrasting nutritional markers were also present in these strains of bacteria.

I divided my experiments into two phases. In phase I, using the gradient plate method, I first obtained a mutant of the ATCC 23590 K-12 F+ strain which appeared to be resistant to Penicillin-G. The next step was to confirm the concentration of penicillin upon which the mutant would grow.

In phase II, I incubated a mixture of the F+ mutant and the F- strains to allow conjugation to take place. At selected time intervals, samples from the above bacterial mixture were plated on minimal media containing Penicillin-G. Plates showing growth after incubation were compared with control plates. Minimal media will not support the growth of either E. coli strain alone. The growth which appeared on the minimal media containing penicillin had to come about through bacterial conjugation.

I concluded that antibiotic resistance along with nutritional factors can be passed from one strain of bacteria to another through the act of conjugation.

#Fourth Award - General Motors ISEF

#TOXIC SHOCK SYNDROME: TAMPONS YESTERDAY AND NOW 'TODAY' - THE CONTRACEPTIVE SPONGE

Preston, Jodie T., Liberty H.S., Bedford, VA 24523
Route 1 Box 112, Huddleston, VA 24104

This study was to determine if the material in different tampons and the contraceptive sponge may enhance the growth of Staphylococcus aureus, the known causative bacterium of toxic shock syndrome. It also involved experimenting to determine if sodium chloride blocks the growth of normal vaginal bacteria, while enhancing the growth of S.aureus and to see if carbohydrate fermentation takes place when the different materials are streaked with normal vaginal bacteria. With Trypticase Soy Agar as the base media, plates were prepared with carbonmethylcellulose (Rely), cotton and polyacrylate rayon (Tampax), and the contraceptive sponge (Today). One set of data was obtained by autoclaving the tampon materials while the other set was obtained by not autoclaving the tampon materials, and including the contraceptive sponge. Using ten serial dilutions of S.aureus, colony counts were performed at 12, 24 and 48 hours. In order to test for carbohydrate fermentation, the tampon materials and the contraceptive sponge were individually added to agar containing phenol red and streaked with normal vaginal bacteria. The ability of S.aureus to withstand large quantities of sodium chloride and the inability of the normal vaginal bacteria to withstand it was demonstrated using mannitol salt agar. On performing colony counts, it was concluded that while superabsorbent tampons and the contraceptive sponge do support the growth of S.aureus, they do not necessarily increase the growth. Other parameters investigated, including time, carbohydrate fermentation, and the presence of sodium chloride do provide evidence that could promote the onset of toxic shock syndrome.

#Third Award - General Motors ISEF

#CONSTRUCTION OF A SAU3A CLONE BANK TO SCREEN FOR GENES ENCODING FOR ALGINIC ACID BIOSYNTHESIS IN A PSEUDOMONAS AERUGINOSA CYSTIC FIBROSIS ISOLATE

Knight, Lisa, Mobile County High School, Grand Bay, AL 36541;
Route 2, Box 312, Grand Bay, AL 36541.

Cystic Fibrosis (CF), the most common genetic disease among Caucasians in the U.S., is characterized by viscous secretions of the tracheobronchial tract. 90% of the mortality and morbidity in CF is due mainly to pulmonary infection of these susceptible lungs.

It has been found that the CF lung is often colonized with Pseudomonas aeruginosa, an opportunistic pathogen which thrives in a moist environment. P. aeruginosa, a gram negative bacterium which is ordinarily found non-encapsulated, is often found encapsulated within the CF lung. The exopolysaccharide produced by these encapsulated strains is alginate, a 1,4-linked copolymer of D-mannuronic acid and L-guluronic acid. Mucoid forms of P. aeruginosa are rarely encountered except in the lungs of cystic fibrosis patients, and colonization of the CF lung with mucoid P. aeruginosa is often a major cause of death.

The pathway of alginic acid biosynthesis by P. aeruginosa is not understood. To gain a better understanding of the alginate genes and what genetic mechanisms control them, it would be useful to isolate these genes and study them.

Recombinant DNA techniques provide a powerful mechanism for isolating these genes onto easily-characterized plasmids and have been used in this study in an attempt to isolate the alginate genes. A collection of 1356 Sau3A clones were isolated and screened for alginic acid production.

#Third Award - General Motors ISEF
Alternate to London International Youth Science Fortnight - United States Navy/Office of Naval Research

THE EFFECT OF CHEMOTHERAPEUTIC AGENTS ON PATHOGENIC BACTERIA AND THE PRODUCTION OF ANTIMETABOLITES DERIVED FROM MOLDS BELONGING TO THE CLASS ASCOMYCETES

Rasmussen, Jill Yvonne, Maddock H.S., Maddock, ND 58348
206 Lincoln, Maddock, ND 58348

I prepared pure cultures of Streptococcus pyogenes, Staphylococcus aureus, and Escherichia coli. I prepared a CAMP test and tested each type for beta-lactamase. Gram, acid-fast, endospore, and capsule stains were also prepared. The Kirby Bauer method was used to test 26 antibiotics. I grew molds and prepared lacto phenol cotton mount blue slides to aid in identification. The mold was grown on potato dextrose agar for 5 days. Antibiosis tests were used to determine if an antibiotic was being produced. Mold was transferred to a tube of tryptic soy broth and glucose. The mold requires a sugar in order to grow. Low concentrations of bacteria are needed to test the antimetabolites as the solutions are weak. I used the disc-diffusion method to test the antimetabolite. All of the cultures were incubated at 37 degrees C for 24 hours before the data was recorded. Penicillin G is the most effective against Streptococcus pyogenes and Staphylococcus aureus. Carbenicillin is the most effective against Escherichia coli. All molds do not produce an antimetabolite. Out of the 45 molds I tested, 13 produced an antimetabolite. This is approximately 29%. The longer the mold is left to grow in the solution, the stronger the antimetabolite will be. The peak of production is after about 30 days. A solution of ethyl alcohol, glucose, tryptic soy broth, and bread mold yielded the strongest antimetabolite. Ethyl alcohol alone has no effect on bacteria.

THE BACTERIAL CONTENT IN THE SALIVA OF DOGS

Last, Kenneth J., Hurricane, H.S., Hurricane, UT 84737
515 S 60 E, Hurricane, UT 84737

INTRODUCTION: My interest in this project was aroused while watching my neice feed her ice cream cone to a neighborhood dog, each taking licks at intervals. Was there something in this type of contact between humans and the saliva of dogs that posed unusual health hazzards?
PURPOSE: To determine the bacterial content in the saliva of dogs in order to determine the dangers involved with it.
HYPOTHESIS: In everyday contact with dogs, there are bacteria in the saliva of dogs that are harmful to humans.
PROCEDURE: To determine the bacterial content, the following methods were used: Using culturettes, I collected saliva from 12 dogs of different breed, age, sex, and teeth condition. Culture plates were produced by inoculating growing media with the saliva from the culturettes. I then selected isolated bacteria colonies from the culture plates and prepared Gram stains. Microscopic examination and biochemical tests were used to identify the bacteria.
RESULTS: The results indicated no particularly virulent pathogens exist in the saliva of the test dogs. All dogs, regardless of the condition of their teeth, appear to contain nothing but normal flora in their saliva. (Normal flora consists of the bacteria and fungi that live in or upon the normal dog without causing disease.)
CONCLUSION: The results of the experiment did not support the hypothesis. Normal contact with dog saliva from healthy dogs is practically harmless.
APPLICATION: Even though the results indicate that dog saliva is practically harmless, domestic dogs should be kept in the best of condition through diet, grooming, teeth care, and immunization. All dog bites and scratches are potentially dangerous.

#BIOLOGICAL STUDIES OF NITROGEN FIXING & ANTIBIOTIC PRODUCING MICROORGANISMS ON LEGUME & NON-LEGUME PLANTS, PHASE II

HRUBY, JOAN L., WILTON PUBLIC SCHOOL, WILTON, ND 58579
R.R. 1 BOX 94, WILTON, ND 58579

Agriculture is the number one industry in the United States and North Dakota. To increase crop production many inorganic substances such as N_2 fertilizers and fungicides are used.In research experiments conducted in previous years I have concluded that there is a good possibility that N_2 fixing bacteria may be able to be used as biological economical substitutes for N_2 fertilizers. The purpose of the first series of my experiment is to determine if N_2 fixing bacteria will provide statistically significant amounts of nitrogen to alfalfa, wheat, oats and corn resulting in increased protein and/or increased grain yields, thus enabling these bacteria to be used as biological economical substitutes for N_2 fertilizers. The results of a field test plot indicate that Azotobacter, Spirillum & Rhizobium meliloti will provide significant amounts of nitrogen to these crops thus leading to good possibilities of these N_2 fixing bacteria being used as biological economical substitutes for N_2 fertilizers. The growth of these N_2 fixing bacteria may be inhibited by the use of inorganic fungicides to control disease. The purpose of the second series of my experiment is to determine if the biological antagonist Pseudomonas cepacia, will successfully inhibit the growth of the major leaf spotting fungus, Septoria nodorum as effectively as fungicides. The results of this experiment indicate that when wheat leaves were inoculated with S.nodorum and P.cepacia on the same day, P.cepacia will successfully inhibit the growth of S. nodorum as effectively as the fungicide Manzate 200. In conclusion, P.cepacia has the possibility of being used as a biological substitute for Manzate 200 to control S. nodorum.

#First Award - General Motors ISEF
First Award - United States Navy/Office of Naval Research

THE COMPARATIVE EFFECTIVENESS IN VITRO OF SEVERAL COMMERCIALLY AVAILABLE FUNGICIDES IN CONTROL OF BOTRYTIS CINEREA

Parker, Andrea L., Loudoun Valley H.S., Purcellville, VA 22132
Route 2, Box 174-A, Leesburg, VA 22075

Botrytis Cinerea is a fungus which causes decay in many fruits and other plants. This experiment was conducted to provide information on the control of Botrytis in grapes. An important decision for the commercial grower is the choice of fungicides to achieve optimum control.

Pure cultures of two strains of Botrytis Cinerea were obtained from the Fruit Research Laboratory of the Virginia Polytechnic Institute in Winchester, Virginia. Selected fungicides - Bayleton, Phaltan, Benlate, and Dithane M45 - were applied to potato dextrose agar medium at one and ten times the field concentration recommended for grapes.

Botrytis Cinerea was transferred onto the innoculated medium and then incubated at 60 degrees F. Observations were made 33, 41, 62, and 86 hours after the transfers were completed. Growth of the fungus was scored at each interval and compared with the untreated control plate.

In the first experiment, none of the fungicides prevented the growth of Botrytis Cinerea in vitro, but Phaltan was the most effective, followed by Bayleton, Benlate, and Dithane M45.

A second experiment, using a Benlate sensitive strain of the fungus, was performed to test the results of the first experiment. Fungicides were applied at ten times field concentration. In the second experiment, Phaltan and Benlate were completely effective in controlling growth. The other fungicides again proved less effective.

Sensitivity of Botrytis to fungicides may vary according to strain. Phaltan was demonstrated to be the most effective in both experiments and should be favored for control.

THE EFFECTS OF GAMMA RADIATION ON THE T4R BACTERIOPHAGE

Al-Qadi, Halimah Ali, A.E. Beach H.S., Savannah, GA 31405;
1126 Maribob Circle, Savannah, GA 31406.

This experiment shows the effects of gamma radiation on the structure and infectivity of phage T4r when introduced to E.coli B bacteria. First, 1.5ml of T4r virus were placed in each of 9 tubes of nutrient peptone broth, 4 of which were placed in the radiation chamber(dosages in Mrads: 0.05, 0.1, 0.4, and 0.5). Nine tubes of nutrient peptone broth, inoculated with 1ml of E.coli B, were incubated at 37°C for 5hrs, and 4 tubes were then placed in the radiation chamber in a 37°C water bath(dosages in Krads: 10, 20, 30, and 40). Each level of irradiated bacteria and an unirradiated control were plated. Four tubes of variously irradiated T4r virus were placed in 4 tubes of unirradiated E.coli B, and 4 tubes of unirradiated T4r virus were placed in 4 tubes of variously irradiated E.coli B. One tube of unirradiated T4r virus was mixed with 1 tube of unirradiated E.coli B. A sample of each E.coli B-T4r mixture was taken 1hr after infection, plated, and incubated at 37°C for 24hrs. These were chosen for electron microscopy: irradiated E.coli B(20Krads)+unirradiated phage T4r, irradiated E.coli B(40Krads)+unirradiated phage T4r, unirradiated E.coli B+unirradiated phage T4r(control), unirradiated E.coli B+irradiated phage T4r(0.1Mrads), and unirradiated E.coli B+irradiated phage T4r(0.5Mrads). Using the same procedure, 2-hr samples were taken. Results show phage T4r infectivity decreases with an increase in the dosage of gamma radiation and that radiation damages E.coli B. Empty viral capsids appear in direct proportion to the increasing radiation dosage given the bacteria, the weakened E.coli B being unable to produce an adequate supply of DNA to fill the capsids. The 2-hr micrographs show a recovery stage.

#Second Award - General Motors ISEF
Honorable Mention - United States Air Force

THE COMPARISON OF ANTIBIOTICS AND ALOE VERA ON BACTERIAL GROWTH: PHASE TWO

SHELLI CHARTER
CLYDE BOYD JUNIOR HIGH SCHOOL, SAND SPRINGS, OK 74063
4901 BARBADOS AVE. SAND SPRINGS, OK 74063

The main objective of this study and comparison is to investigate the possible inhibitory effect of Aloe Vera juice on six species of pathogenic bacteria. The juice from the aloe leaves is compared to the effectiveness of three common antibiotics.

Test were conducted under conditions of 37°C, normal body temperture. The bacteria used was Streptococcus pyogenes, Klebsiella, Pseudomonas aeruginosa, Candida albicans, Escherichia coli, and Staphylococcus aureus. All of these bacteria are related to the infections found in burns, boils, and abscesses in the skin.

In Phase I, Aloe Vera was used on three unknown type of bacteria. In conjunction with the Aloe Vera test[1], a comparison was made: Tetracycline, Neomycin Sulfate, and Penicillin were all compared to the Aloe Vera.

Phase II compares Tetracycline, Gentamycin, and Penicillin to the Aloe Vera.

Phase II also goes further with an examination of what Aloe Vera exactly does.

Unlike Phase I, Gentamycin proved the most effective. Tetracycline was the second most effective, and Penicillin was the least effective of the antibiotics in controlling bacterial growth. Aloe Vera promoted bacterial growth, so naturally, it is the least effective in controlling bacterial growth, but through research I have found that Aloe Vera possesses an element thought to be benificial to healing.

#INACTIVATION OF A MURINE POLIOVIRUS IN RAW AND DIGESTED SLUDGES

Barker, Thomas E., East Noble High School, Kendallville, IN 46755
R# 3 C. R. 850 N., Kendallville, IN 46755

Recent concern with using sludge as a fertilizer has stemmed from the fact that viruses are indigenous to this solid waste. The objective of this research was to evaluate viral inactivation by temperature--the primary factor in sludge digestion processes which is responsible for viral inactivation.

Raw and anaerobic, mesophilically digested sludges were seeded with mengo encephalomyelitis virus after preliminary testing for cytotoxicity. Seeded sludges were then kept at 4°C and/or 35°C for 48 hours. Sludges were then run through a modified viral elution procedure and concentrated via an organic flocculation method. Resulting flocs were assayed on L(M) cells. Plaques were counted and titers determined.

After 48 hours at 4°C virus recovery was 38% in raw sludge and 16.74% in digested sludge. After 24 hours at 35°C and 24 hours at 4°C recovery was 26.1% in raw sludge and 0.32% in digested sludge. After 48 hours at 35°C recovery was 0.092% in raw sludge and 0.043% in digested sludge.

Conclusions drawn were: 1) Virons were readily recoverable from seeded sludge. 2) Temperature significantally inactivated virus in sludge. 3) Viral inactivation was greater in digested sludge than in raw sludge. 4) Although viral inactivation does occur in the digestion process by temperature, the possibility remains that virus does in fact survive. Thus care should be taken before using sludge as a soil supplement or conditioner.

#Third Award - General Motors ISEF
Alternate to Scholarship - Ohio State University

AN ECOLOGICAL SURVEY OF A FRESH-WATER ENVIRONMENT

Darla brock
White County High School, 256 Allen Drive, Sparta, TN 38583;
Route 2, Box 113, Sparta, Tennessee 38583

The sensitive balance of nature is easily upset. It is of great importance to be aware of the projected consequences of environmental change. One such transformation results when a free-flowing stream is impounded thus, creating a pond.

A model reproduction of such a situation was prepared with the use of a stream and an aquarium. It then became plausible to explore the specified parameters of such a change through comparative testing on a monthly basis. The effect upon microbiological life was observed by extensive microscopic analysis of water samples. Variations in dissolved oxygen, free carbon dioxide, and pH were determined through frequent experimentation. More than a year of scientific research culminated with some significant conclusions.

Organic content tends to indicate that ponds sustain a larger variety of microorganisms in more complex forms than do streams. With the increase in temperature comes an increase in microorganic presence. Both the dissolved oxygen and the free carbon dioxide content of streams prove higher than that of ponds. A higher satisfaction of the biochemical oxygen demand exists in streams. Thus, stream water possesses little oxidizable material. Pond water tends to be more acidic than stream water, and a stream contains more bacteria than a pond.

Testing was then performed on an actual stream impoundment. Chemical and physical factors were monitored, and microscopic life was photographically recorded. Identical analysis of the free-flowing stream was carried out under like conditions. The accuracy of the model was tested.

RELATIONSHIPS OF ENVIRONMENTAL POISONS TO AQUATIC BACTERIA

Gavin, Jennifer, Holmes County High School, Bonifay, FL 32425
Route 2, Box 170, Bonifay, FL 32425

The major purpose of this experiment was to find out if different amounts of two classes of commonly used poisons added to selected portions of freshwater and marine ecosystems for varying time exposures would affect not only the population densities but also the protein composition of the bacteria usually found associated with these ecosystems in proportion to the amount and kind of poison added as well as to the length of their exposure to that poison.

The bacteria were aseptically isolated, cultured, maintained, and identified through standardized microbiological procedures. The environmental conditions for testing both the standards and experimentals were identical. The experimentals were exposed for 24, 48, and 72 hours at .01 and .05 levels of poisons. Population densities were determined by using the Spectronic 20 and the amino acid composition of the bacteria identified by using thin layer chromatography. The experimentals were then compared to the standards.

The general pattern for the population densities was for the standards to exhibit the most growth, insecticide treated the next amount, and the herbicide treated the least amount of growth at the .05 level. There was less differentiation apparent at the .01 level. The length of time involved also appeared to affect the population densities. The TLC data indicated that the poisons affected the amino acid composition of the isolates at both the .01 and .05 levels out of proportion to the usual "random" sampling for the amino acids found in the standards.

THE EFFECTS OF TWO RHIZOBIUM INOCULANTS ON THE GROWTH OF TRIFOLIUM REPENS AND SOYBEANS WITH VARIOUS NUTRIENT DEFICIENCES AT DIFFERENT pH LEVELS UNDER FIELD AND GREENHOUSE CONDITIONS

LISA ANN PERKINS
BRIARWOOD SCHOOL; PALATKA, FLA. 32077

RT. 4, BOX 1063; PALATKA, FLA. 32077

The purpose of this experiment is to demonstrate the effects of two rhizobium inoculants on the growth of Trifolium repens and soybeans with various nutrient deficiences at different pH levels under field and greenhouse conditions.

To start my experiment five Trifolium repens and three soybeans were each placed in 150 growth pouches. Each type of plant was then seperated into thirty groups, each containing five growth pouches. Next fourty Trifolium repens and two soybeans were each placed in thirty clay pots with each of these type of plants being seperated into thirty groups.

Next I mixed one liter of distilled water with the nitrogen solution, one liter with the rhizobium, and three liters with each nutrient solution. I then mixed the builder's sand with both the soybean and Trifolium repens inoculants.

The first thing I did was to take twenty groups of soybeans and Trifolium repens in both growth conditions; inoculate them with one milliliter of the appropriate rhizobium inoculant and give them either a pH of 7, 4, or 10. Each type of plant was then watered with a different nutrient solution.

The next group of three with both types of plants were done the same but were not inoculated with the rhizobium.

For the last part of my experiment the controls were completed. These were done by watering the seeds of both plant types with only distilled water and giving each group a pH of 7, 4, or 10.

The Trifolium repens and soybeans with the appropriate rhizobium, grown with all the nutrients in a pH of 7 had the best overall growth.

UNIQUE ANTI-AGENT INVESTIGATIONS

Kothenbeutel, Jane E., Marshalltown H.S., Marshalltown, IA 50158
406 North 9th St., Marshalltown, IA 50158

The purpose of my project was to see if I could find a new, natural, stronger anti-microbial agent. I chose to work with aloe vera, capsaicin, and interferon. Six different microbes were also chosen.

Each substance was applied to each microbe culture. The aloe vera and capsaicin were applied directly, while the interferon was applied via a sterile disk saturated with .125 cc interferon. After an incubation period of twenty-four hours, the inhibition zones were measured and graphed. This was done every twenty-four hours for six days. After determining that human interferon produced the largest inhibition zones, I performed serial dilution tests. Interferon was serially diluted from 10,000 ppm to 1 ppm, applied to microbes, incubated, and inhibition zones were measured.

After testing, I observed that microbes treated with aloe vera showed no inhibition zones. Three of the six microbes treated with capsaicin showed large inhibition zones, while the other three remained unharmed. I concluded that aloe vera did not have anti-microbial properties and that capsaicin seemed to be a selective anti-agent.

The interferon tests showed large inhibition zones. When compared to six known antibiotics, interferon had the larger inhibition zones. Even when diluted it maintained some of its effectiveness down to 100 ppm. I concluded that interferon might be an effective anti-microbial agent.

STUDY OF THE ANTITUMORAL, ANTIBACTERIAL, AND ANTIVIRAL ACTIVITY OF DIFFERENT MEDICINAL PLANTS AND ALGAE FROM THE LITORAL ZONE OF NORTHEAST, P. R.

Adrián Díaz - Dr. Santiago Veve Calzada High School
Fajardo, P. R., 00648
Calle 1, A-4, Santa Isidra 4, Fajardo, P. R., 00648

In Phase 1 and 2 of this study, the plant known as Plantago-Ginis demonstrated to have 100% effectiveness in the control of cancer cells of the Erlich Ascetics Tumor (E.A.T.) when twenty experimental mice were innoculated with it. Ten of them were treated with the distilled elixir of the plant and the other ten with the active component. Another twenty mice were utilized as a control group. Factors such as weight, hemoglobin, white blood cells, red blood cells, etc., were observed. The conclusion reached is that Plantago-ginis is not only effective in the control of the E.A.T. but also serves to strengthen the immune system of the mouse.

In Phase 3, 100 medicinal plants, including the Plantago-ginis and 15 algae, were utilized as natural antibiotics against different pathogen bacterias including N. gonorrhoeae PPNG and the fungus C. albicans. Solid and liquid extracts were proved making use of minimal inhibitory concentration tests. Of the plants utilized the following demonstrated to have 100% effectiveness against ten organisms: Eupatorium portoricense, Pimenta racemosa, Bursera simaruba, Chenopodium ambrosioides, and Calophyllum brasiliense. Only one of the algae was effective.

In Phase 4, "in vitro" studies were realized with the 6 effective plants and one alga against Herpes simplex virus type 2 (HSV-2). Different extracts of each plant and algae were dissolved in the culture medium on a monolayer innoculated with HSV-2 and on noninfected cells. The investigation reveals that the Eupatorium portoricense has 100% of effectiveness in the inhibition of HSV-2.

DISINFECTION AND RESISTANCE DEVELOPMENT IN BACILLUS subtilis STRAINS

Pinkofsky, Richard E., Stoughton High School, Stoughton, MA 02072
88 Winslow Drive, Stoughton, MA 02072

The objectives of my project, conducted for approximately three years, were: 1. To determine the effectiveness of phenolyic Lysol, quaternary Lysol and Real-Pine on B. subtilis. 2. To develop resistant B. subtilis strains in the presence of a known bactericide.

By developing my own growth classification and sporulation classification systems, I achieved my results. Growth was classified, utilizing a uniform inoculum, as follows: no growth = NG, growth twice the thickness of the inoculum = M and growth greater than twice the thickness of the inoculum = E. Sporulation was classified as follows: O = no spores, NS = less than or equal to 1% spores, S^- = less than 50% spores, S = 50% spores and S^+ = greater than 50% spores.

The results yielded were: 1. Phenolyic Lysol produced M growth and S^+ spores. 2. Quaternary Lysol produced NG growth and NS spores. 3. Real-Pine produced NG growth and S^+ spores. 4. All cells were killed when exposed to a second dosage of each of the disinfectants. 5. When subcultured to fresh agar, cells exposed to phenolyic Lysol and Real-Pine produced E growth and S^+ spores, while cells exposed to quaternary Lysol produced NG growth and NS spores. 6. Resistant strains were developed in the presence of quaternary Lysol.

Thus, phenolyic Lysol and Real-Pine were found to be bactericidal. Resistant strains can, nevertheless, be developed in the presence of quaternary Lysol.

#A SIX YEAR STUDY OF SACCHAROMYCES CEREVISIAE

Nettles, Amy N., Oak Grove High School, Hattiesburg, MS 39401;
165 Beechwood Dr., Hattiesburg, MS 39401

The relative growth of Saccharomyces cerevisiae may be observed by measuring the carbon dioxide produced during fermentation. This method was used to determine that the optimum temperature for growth of Saccharomyces cerevisiae is 30°C and that the optimum nutrient is fructose.

Since the organism's best environment has been determined, the question was raised, "What happens when the culture is bombarded with radiation?" To answer this question the following procedure was used. (1) 108 cultures containing 0.5 gram Saccharomyces cerevisiae, 1.0 gram sucrose, and 2 milliliters water (30°C) were irradiated with 0, 500, 1,000, 2,000, 3,000, 4,000, 10,000, or 20,000 rads (Cobalt-60 source). (2) 12 portions of 0.5 gram Saccharomyces cerevisiae were irradiated with 1,000 rads. Then 1.0 gram sucrose and 2 milliliters water were added. (3) 12 more portions of 0.5 gram Saccharomyces cerevisiae and 2 milliliters water were irradiated with 1,000 rads. Then 1.0 gram sucrose was added. Then all 132 cultures were attached to water displacement apparatus, and the carbon dioxide production was measured for 2 hours in 5 minute intervals.

The results of this experiment showed a definite decrease in the carbon dioxide production of the portions irradiated during the dormant state. Also, the portions irradiated during the active state showed little difference from the control. However, the cultures irradiated with 1,000 rads during the growing state exhibited a dramatic enhancement of carbon dioxide production through initial lag time, rate of production, and total production. This phenomenon indicates that this is a promising area for development of improved products.

#Honorable Mention - American Chemical Society

#HERBICIDAL INFLUENCE UPON SOIL BACTERIA

Gemmill, Jane Marie, Fordville Public H.S., Fordville, ND 58231

Route 1, Box 5, Fordville, North Dakota 58231

How do commercial herbicides effect the soil bacteria populations when applied to soils? With the presently employed herbicides, there has been no indication that normal applications seriously injure the microflora or microbial processes in soils. However, my experiments show that normal rates of treatment are injurious to the bacteria inhibiting the thin layer of soil near the surface. Rapid recovery of these bacteria can be expected upon the disappearance of the herbicide but continual use, heavier application or more toxic poisons do have a detrimental effect upon these important soil microflora.

The purpose of my project was to determine how toxic various herbicides were on population counts of soil bacteria exposed to the herbicides (either by direct or indirect methods). As any farmer should know, the soil bacteria are absolutely essential to the recycling of plant materials into humus through natural decomposition processes for the enrichment of soil. My experiment employed the use of six preemmergent and post emmergent herbicides (Banvel, Carbyne, Roundup, Stampede, Tolban, and Treflen) diluted to .001% approximately the same rate as used on soils. The tests performed were: indirect application of herbicide - soil sample dilution plate counts on three different nutrient media and the soil slurry - direct application of herbicide on samples - plate - dilution counts for residual effects after one - five and fourteen days.

In all my tests, I concluded that all of the herbicides had some to a great deal of toxic influence on the soil bacteria.

#Honorable Mention - Bureau of Reclamation/U.S. Department of the Interior

NUTRITION OF YEAST: WHAT IONS ARE NECESSARY FOR GROWTH?
Smith, Suzanne E., Corning High School, Corning, CA. 96021; 5500 Edith Ave., Corning, CA. 96021.

I studied the growth of yeast in a pure, synthetic media for three days. The conditions were with and without air, at 90°F, a temperature which was determined optimum for the growth of yeast.

Each test bottle contained three of the four ions. The ions were Na^{+}, K^{+}, Ca^{++}, and Mg^{++}. The bottles with the deleted ion was labeled -NaCl, -KCl, etc. In addition to the ion solution, a nutritional stock solution provided the yeast food to grow.

After three days, the yeast was taken out and filtered. The yeast growth was measured by filtering, drying, and weighing. Acids were measured by titration with .1 normal sodium hydroxide. Alcohol was measured with a hydrometer and calculated from factors for specific gravity. Normally with complete nutrition, yeast metabolism produces more growth and acid under aerobic conditions and less growth but more alcohol under anaerobic conditions. This is an observation of the "Pasteur Effect".

It appears that yeast does not grow or metabolize normally if Mg ions are absent. Near normal metabolism but poor growth is observed in the K^{+} deficient yeast. Fairly normal metabolism and near normal growth is observed for yeast growing in the absence of sodium. Good growth was obtained in the calcium deficient sample but altered metabolism resulted in less alcohol under anaerobic conditions and less acid under aerobic conditions.

THE EFFECTS OF COLCHICINE ON MITOSIS: IS CYTOKINESIS REALLY PRESENT?
Dwyer, David K., C-PP West High School, Painted Post, NY 14870; 2 W. Chatfield Place, Painted Post, NY 14870

The objective of this investigation was to study the effects of colchicine on cell mitosis. Prior research has determined that colchicine prevents spindle fiber formation; consequently, it was anticipated the colchicine would cause abnormal numbers of chromosomes in the daughter cells. It was also anticipated that the cells would not survive long periods of exposure or high doses, and these effects would be permanent.

Contrary to what was first believed, this study revealed that the cells were able to pass through mitosis but they were unable to actually divide. No treated cells were observed going through cytokinesis. The increase in mitotic cells was attributed to a prolonged mitotic period caused by the colchicine. There was a large increase in cell size from the lack of cell division. Colchicine brought observable side affects on cellular metabolism, specifically the decreased utilization of glucose. The cells proved to have a much greater resistance to the colchicine than first thought. For example, they were able to survive doses of 1×10^{-6} gms/ml for periods of greater than 100 hours. However, a number of the cells had a multinuclear structure. Finally they seemed to have a rapid recovery rate once the colchicine was removed. For example, after being treated for 48 hours in a dose of 1×10^{-7} gms/ml the cells were able to return to normal size within a period of two days.

A COMPARATIVE, BACTERIOLOGICAL AND CHEMICAL STUDY ABOUT SOME OF THE MOST CONSUMED MEATS BY THE EXISTING POPULATIONS IN SOME NORTHERN, EASTERN AND WESTERN REGIONS OF PUERTO RICO

Santiago, Stanely, C.R.O.E.M. High School, Mayaguez, P. R. 00708;
Res. Mirasol, Buzón 2613, Aguas Buenas, P. R. 00667.

In Puerto Rico there are a great number of persons whose health is affected by bacterias. For this reason I decided to investigate the detection of bacterias that are able to affect human health of some varieties of meat of great comsuption among the population of differents parts of Puerto Rico.

This investigation has been made to determine which pathogenic bacterias are found in the meats of great comsuption by the population of some regions of north, south, east, and west of Puerto Rico.

Some of the specific techniques used in the study of meats were the preparation of agar cultures, crystal plates, Gram dies, etc. In the first phase of my study, an experiment in the beef meat was made. In the second, an experiment in the pork meat was made. In this phases the bacterias were cultivated in gravy and then they were placed on the blood agar cultures. After 24 hours the bacterias were identified.

Others phases of my study were made with chicken meat in which the same procedure just mentioned were used.

Once the experimentation was finished, it could be concluded that in some of the most consumed meats by the people of some regions in the north, south, east and west of Puerto Rico, the growth of bacterias capable of affecting human health is quite possible.

PHYSICS

THE RETURN OF THE BOOMERANG

Moore, James C., Texarkana Arkansas H.S., Texarkana, AR 75502;
Route 10, Box 803, Texarkana, AR 75502

The objective of this project was to build several boomerangs each varying only by a single factor such as airfoil shape, arm length(s), the central angle, and mass. Using the charted flight patterns of the boomerangs, the effects of each factor on the boomerang's flight could be determined.

In PHASE I, testing was done by visual comparison of flights via throwing two boomerangs at the same time. In PHASE II, more detailed observarions were obtained through the use of photography. Also, more precise boomerangs were constructed.

In conclusion, it was found that a more streamlined airfoil tends to make a smoother and rounder progression; longer armed boomerangs tend to travel slower and have a lower apogee; boomerangs with longer trailing arms are more stable and fly lower than those with shorter arms; slightly forward swept arms provide a very low and round progression, but lacks vertical lift; finally, 100-120 degree central angles provide the most stable flight.

#Honorable Mention - National Aeronautics and Space Administration

#HEAT RADIATION: INFRARED VS VISIBLE LIGHT

Berneburg, Cristopher Jon, Heritage H.S., Lynchburg,Va.24502
214 Simsbury Ln., Forest, VA., 24551

The purpose of this project was to find a relationship between the infrared radiation and the visible light emitted by a metal at low and high temperatures.

The materials used for the experiment were two Wheatstone bridge circuits and two phototransistors, a thermometer, and a test meter.

The two phototransistors were directed toward a burner of the electric stove. One phototransistor detects infrared radiation while the other detects visible light. Meter readings of infrared radiation and visible light emitted by the stove burner were recorded while the stove setting was turned up in equal intervals. Temperature readings were recorded also.

It was found that the visible light phototransistor detected light even though no visible light was seen with the naked-eye. With this, no conclusion could be drawn on the hypothesis. However, suggestions for improvement and explanations offer possible solutions.

#First Award - National Aeronautics and Space Administration

#SOLITONS: A COMPUTER AND EXPERIMENTAL STUDY

Simon, Kent Dana, Auburn H.S., Auburn, Alabama 36830
431 Scott St., Auburn, Alabama 36830

This project was an experimental and computer simulation of solitons. The project was divided into three major parts.

Part one consisted of determining the properties and equations of solitons from current literature. These results from the literature are:

1. Solitons have a crest only, this crest varies as a $Sech^2$ funct.
2. The speed of propagation of a soliton is directly proportional to the square root of the amplitude.
3. The width of a soliton is inversely proportional to the square root of the amplitude.
4. In interactions, solitons pass through one another in a nearly elastic fashion.
5. Long solitary waves will breakup into several solitons.

The solution to the soliton wave equation was found to be:

$$\phi(x,t) = 3v(Sech^2(v^{\frac{1}{2}}(x-vt)/2))/a.$$

Part two consisted of the testing and confirmation of the theoretical predictions in a 16 ft wave tank.

Part three amounted to telling the computer the solution to the soliton wave equation and then having it respond by simulating solitons under various conditions.

Theoretical findings from the literature, experimental work, and the computer simulations were in excellent agreement.

#Second Award - Acoustical Society of America
Second Award - Marine Technology Society/U.S. Naval Institute
Alternate to London International Youth Science Fortnight and Scholarship - United States Navy/Naval Ocean Research and Development Activity

MATHEMATICAL ANALYSIS OF SEVERAL IMPROVED LOW ENERGY COMPTON SCATTERING MODELS

Brothers, Maxwell J., Bloomington High School North, Bloomington, IN 47401; 120 S. Park Ridge Rd., Bloomington, IN 47401

The solution set (or basis set) to the Schroedinger equation for atoms of higher complexity than hydrogen is beyond the capacity of modern mathematics. (This is the N-body problem.) This has led to the development of sophisticated methods for numerically obtaining an approximate basis set - such as the Hartree-Fock (HF) or CI methods. The momentum space wave function $\chi(\vec{p})$ is intimately related to the position space wave function $\Psi(\vec{r})$ through the use of the Dirac transform. As long as high energy transfer from the incident photon (the probe) to the target atom occurs, Compton scattering is directly related to $\chi(\vec{p})$ since the Compton scattering experiment measures the orbital electrons' momentum densities $\rho(\vec{p})$ $(=\chi^*\chi)$. Therefore, Compton scattering can be used to verify the quality of an HF basis set. However, due to technological limitations on γ-ray sources (high energy sources), it is necessary to use the highly developed x-ray sources. The theory applicable to high energy transfers (γ-ray sources), though, deviates in the lower energy transfer region (x-ray sources). My research has involved the mathematical evaluation and rigorous analysis of improved models in the x-ray region of energies.

The analysis has involved the correlation of the mathematical calculations with very precise measurements of an $(e^-,2e^-)$ experiment in which He, Ne and Ar were used as target atoms. Hence, the results are comprehensive. Two of the models are in very good agreement with the experimental measurements (ie., they are generally within the experimental error limits). These two models can be applied to x-ray Compton experiments with a great degree of accuracy since the $(e^-,2e^-)$ experiment has a much higher sensitivity to the models than the Compton experiment. In addition, the mathematical derivations are immediately applicable to the x-ray experiment since the two experiments are mathematically similar.

#First Award - National Aeronautics and Space Administration
First Award - United States Navy/Office of Naval Research
London International Youth Science Fortnight - United States Army
Second Award - General Motors ISEF
Third Award - American Association of Physics Teachers

A NEW METHOD FOR THE DETERMINATION OF SURFACE TENSION

Cherry, Donna, Warren East H. S., Bowling Green, Ky. 42101
Rt. 7, Box 102, Bowling Green, Ky. 42101

The purpose of this project was to formulate a new method for determining surface tension of water. This new method would be on a simpler level than the current methods.

Forces acting on a stream of free-falling water were found by research. By taking measurements of the unbroken cone of water and the droplets, the surface tension of water should be calculated.

Two experiments were done to test this new method. Both were designed to eliminate the factor of pressure forcing the water out of the pipe. Photographs were taken of the stream placed in front of a measuring device, in order to ensure more accurate measurement. These measurements were inserted into the hypothesized formula.

When the calculations were completed, the resulting values of surface tension were compared with known values of surface tension. Because of a large difference between the calculated values and the known values, it was concluded that the new method was not completely accurate because of a few factors that were indefinite. Investigations are still being done to determine definite values for these factors.

#SOLAR MOTOR - SOLAR ENERGY FOR THE FUTURE

Goodell, W. Michael, L. D. Bell H.S., Bedford, Tx. 76021;
3701 San Bar Lane, Bedford, Tx. 76021.

The purpose of this project is to construct and investigate the feasibility of a polyethylene solar motor. Such a motor uses strips of stretched polyethylene plastic to convert solar energy into mechanical energy. These strips act like a muscle, contracting when struck by sunlight, and relaxing when cooled. When mounted around a centered axis on a wobble wheel, strips at the top of the motor contract, pulling the flywheel above its center of gravity and causing the motor to rotate. A small scale motor was built and its principles of operation were investigated. Measurements of torque and light intensity versus RPM were recorded and graphs of these data were plotted. It was easy to see that improvements could be made to this motor. Wider polyethylene bands, a heavier flywheel, and better motor geometry were incorporated. Each improvement resulted in increased torque and RPM, and the final results were plotted on a graph.

From these observations it was concluded that a solar motor of this type could be an effective means of providing inexpensive energy. Irrigation, pumping of oil, and production of electricity are possible uses for this type of solar motor. With further development, the solar motor could be a feasible and efficient way to provide power for the future.

#Honorable Mention - National Aeronautics and Space Administration

#FACTOR ANALYSIS OF RAMAN SPECTROSCOPIC ULTRALINEAR POLYETHYLENE COMPUTERIZED DATA MATRICES

Wu, Theodore T., W.T. Woodson High School, Fairfax, Va. 22031
8925 Burbank Rd., Annandale, Va. 22003

The purpose of the project is to confirm the existence of the intermediate high-pressure phase of linear polyethylene and to determine the effects of scaled noise on a data matrix system. A FORTRAN program was written for the Vector computer at the Naval Research Lab to analyze data from a Raman spectrometer. The spectroscopic data matrices were modified by factor analysis techniques in the program. Linear regression of the noise-introduced program data outputted slopes of lines. The slopes for different-sized matrices were then compared. The establishment of a unique spectral signature for linear polyethylene at 3.84 kBar confirmed the existence of an intermediate high-pressure phase. In the intermediate phase, parallel molecular alignment results in a tensile strength 3X that of steel, a finding with enormous potential! In the theoretical study, there was a direct proportion between the slope and the number of spectra being analyzed. Future testing may be needed to verify the proportionality. The significance of determining the relationship between slope and matrix size is that the effect of noise on a set of scientific data in any experiment can be predicted before the experiment is performed, thus pinpointing the range of experimental error.

#Third Award - General Motors ISEF

WIRELESS TRANSMISSION OF ELECTRICITY BY MEANS OF AN OSCILLATING TRANSFORMER

Chapman, David R., Central High School, St. Joseph, Mo 64501
1406 Rifle Terr., St. Joseph, Mo. 64506

Nikola Tesla, a physicist of the late nineteenth century, stated that wireless transmission of electricity by means of an oscillating transformer was possible. The research was done to determine if electricity can be transmitted without the use of wire by means of a "Tesla coil" (oscillating transformer). Voltage was measured at varying distances to test the effect of distance on the voltage received. Also, steel dishes (26cm diameter, 5cm deep) were attached to the volt meter probe to test different amounts ot receiving area on voltage readings. From the distance experimentation it was determined that the measurable electricity dissipates by the inverse square law. Because of this rapid dissipation, the Tesla coil would only be effective over comparatively short distances. When a 2.5cm probe was used as a receiver 10 volts of electricity were recorded at 40 centimeters. When two steel dishes were in connection with the probe a 470% increase in voltage was measured. Experimentation with reflectors and a receiving coil was performed by the data proved to be inconclusive. Electricity in the form of high frequency radiation can be transmitted over relatively short distances in comparison to conventional methods. In the case of this Tesla coil approximately 3 meters (with two receiving dishes) is the furthest point at which 1 volt of electricity can be registered.

RELATIVISTIC COSMIC ANOMALY

Méndez-Torres, Abel, Lino Padrón Rivera H.S., Vega Baja, PR 00764
Bo. Almirante Sur, Km. 8.6, Vega Baja, PR 00764

Physics needs an unification of the laws for the best physical understanding of the cosmos. There exists equivalency between gravity and acceleration; energy and mass; and space and time. Each pair of concepts has been unified. In other words, all concepts could be unified together to stablish an equivalency of each concept. The equations that express the equivalency of each pair of concepts, are the following:

$G_v=a/g$; $E=mc^2$; $s=ct$ where, G_v=gravity, in units Earth equal one; a=acceleration; $g=9.8\ m/s^2$; E=energy; c=speed of light; t=time and s=space.

If the variables are cleared away, the unified equations and equations that have been established are applied. The result being that these equations are the ones that unify most of the physical laws. These equations joined together are the equations that make up the central body of physical equations, from which all other equations are derived.

The anomalies and relativity that were presented in posterior laws, could be eliminated or clarified based on the researched unifying theories of the field.

#THE NITROGEN LASER

C. Alex Young, 310 East Texas Street, Ruston, LA 71270
Ruston High School, Cooktown Road, Ruston, LA 71270

The laser, a device that has revolutionized science and industry, is based upon the stimulated emission of light. This energy release process of coherent light is explained by the quantum theory with the equation, $E = hf$.

A nitrogen laser was constructed and used to pump a Rhodamine G6 liquid dye laser. A Wimshurst machine was also constructed for the power source. These devices were employed to investigate the relationship between dye concentration and threshold voltage of the dye laser.

Experimental data revealed an inverse relationship between dye concentration and threshold voltage; that is, as dye concentration increased, the threshold voltage decreased. Thus the intensity of the laser beam can be increased, by employing dye, allowing for smaller power usage. This process for improved efficiency could have great impact in the use of the laser for navigation, range-finding, and communication.

#First Award - Vacuum Technology Division of the American Vacuum Society

WHAT ARE THE EXPERIMENTAL LIMITS OF BOYLE'S LAW?

Crowley, Kirk L., Monticello H.S., Monticello, UT 84535
East Route, Monticello, UT 84535

My project is designed to find the experimental limits of Boyle's Law (Pressure x Volume = A Constant).

My main objective is to see whether or not Boyle's Law holds true. If it does not, I want to try and find the point at which it fails to be mathematically valid.

From this investigation I hope to gain a greater understanding of molecular behavior.

I designed and built an airtight hydraulic cylinder with which I was capable of achieving up to 15 atmospheres pressure while accurately measuring the resulting volume.

Experimental data indicated the mathematical law has limits. I am prepared to offer additional hypothesis concerning molecular behavior which may explain these results.

#TURBULENT AND LAMINAR FLOW

Barrick, Stephen C., Boulder City High School, Boulder City, NV 89005; 590 Shoshone Way, Boulder City, NV 89005.

Purpose:	To determine the applicability of Reynolds equation to turbulent and laminar flow.
Procedure:	First I built an apparatus in which turbulent and laminar flow could be demonstrated. Next I determined the critical Reynolds number for this apparatus. I then mathematically predicted the head that would give the critical Reynolds number in various diameters of tubing at different temperatures.
Results:	Testing proved that my predictions were correct.
Applications:	Turbulent and laminar flow occur in various areas such as aerodynamics, electronics, and fluid dynamics.

#Fourth Award - General Motors ISEF

THE USE OF A WATER TABLE IN DETERMINING THE EFFECTS OF DIMPLING ON GOLF BALL FLIGHT

Richardson, Edward J., Knoxville Catholic H. S. Knoxville, TN 37917
324 Sevenoaks Dr., Knoxville, TN 37922

Why are golf balls dimpled? This is the reason: On a smooth ball the air separates from the front without entering the back very much. Because the air is not entering the back, the pressure behind the ball is less than the pressure in front of the ball. This difference results in a partial vacuum behind the ball. This vacuum will "hold back" the ball. The rough surface of the dimples delay the separation, allowing the air to come behind the ball more easily. This equalizes the pressures of the front and back which results in less drag to the ball. To determine the best combination of diameters, depths, and number of dimples, a water table (which is used to study two-dimensional flows) was constructed and wooden models were tested with it. These models were made by boring holes in wood. To simulate dimples, grooves were made in the models with a small hobbyist-type drill. Crystals of potassium permanganate were placed at regular intervals on the table. These crystals released lines of dye as they dissolved in the water. The models were tested by placing them in the flow of these lines. Comparisons were made by measuring the distance from the back of the ball to the point where the lines become straight again. It was determined that the optimum depth for a given diameter should be less than half the diameter. If the depth is more than half the diameter, the dimples produce vortices and the ball becomes inefficient.

#A PROTOTYPE DUAL CIRCULAR POLARIZED SATELLITE/AEROSPACE COMMUNICATIONS ANTENNA: A TWO PHASE ANALYSIS

Henderson, J. Daniel, Bonneville H.S., Ogden, UT 84405;
P.O. Box 486, Roy, UT 84067

The purpose of my research project was to examine the feasibility of building a dual circular polarized antenna design with a single, uniquely engineered driven element to obtain a minimum gain of 10 db.

In order to achieve this purpose, I developed this project in two distinct phases: The primary phase consisted of building the antenna and 1/4 wavelength resonance cavity for an operational frequency of 21.150 MHz. The antenna of this phase was tested at frequencies other than that for which it was designed so that the full capabilities of the antenna could be assessed. The secondary phase of the project consisted of building the antenna with a full wavelength resonance cavity and operational frequency of 151.625 MHz. This antenna would have its operation verified via actual communications.

I found that it is in fact feasible to build an antenna that utilizes a single driven element to obtain dual circular polarization while still obtaining gain suitable for reliable communications. The antenna I designed had a gain of 12.5 db, and field strength patterns and communications tests indicated that it was in fact transmitting a signal that was dual circularly polarized.

The antenna design that I have developed could easily be used for satellite communications and high speed computer data links. It could also be utilized in areas where a large communications antenna was not feasible, because my design still maintains a high degree of efficiency without a resonant cavity.

#Third Award - General Motors ISEF

CONSTRUCTION OF AND EXPERIMENTATION WITH A FOOD DYE LASER

Henderson, Timothy A., Decatur H.S., Decatur, Arkansas 72722
Rt. 1, Box 52, Decatur, Arkansas 72722

PROBLEM: Can a laser be made out of food dye contained in a glass tube?

HYPOTHESES: I feel that through the research and experimentation I have done, I can show the close comparison between the lasing power of the Food Dye Laser and the Chromium Nitrate Laser.

The tubes were filled with dye of different colors. The ends of the tubes were heated and closed, and then fire-polished. The tubes were inserted into a 1-foot square box made of mirror tile. The box has a full mirror and a partial mirror. The box was made of tile to help increase oscillation. The box was then covered with aluminum foil, with a small opening left for the flashlamp. When the flashlamp emitted a burst of light onto the green tube, the glass took on a bright blue-green tinge. As I set off the flashlamp over and over, as rapidly as possible the dye became more excited and after 10 flashes a short-lived green beam was emitted from the the tube's end. It made a moderate burn in comparison with the Chromium Nitrate Laser.

CONCLUSION: A dye laser can be composed of food dye contained in a glass tube. By the use of graphs, the comparisons between the green, red, and blue food dye lasers can be more easily visualized.

#X-RAY EMISSIONS IN A PROTON PARTICLE ACCELERATOR

Sheridan, Philip H., Lutheran High School North, Mt. Clemens, MI 48044
20139 Scarlet Ct., Mt. Clemens, MI 48043

The two-fold purpose of this project is to not only construct a functional homemade proton particle accelerator, but to also determine the penetrability of the emitted x-rays from the target metals. The particle accelerator involved a vacuum tube with spaced corona rings, a hydrogen admitting-ionizer apparatus at the upper end, and an accessible target chamber at the lower end. It also involved a Van de Graaf generator, a Geiger-Muller detector with scaler, and a vacuum system that secured a pressure of 10^{-5} Torr. The procedure involved placing a pure metal target in the target chamber. The liberated protons from the ionized hydrogen were accelerated by the potential difference created by the Van de Graaf generator. The resulting proton beam was observed when it caused a quartz disc, positioned above the target material, to fluoresce. Collimation was achieved by means of a discharge needle inserted through the second corona ring. The quartz was then swung out of place, allowing the proton beam to strike the target material, generating x-rays. Varying thicknesses of lead and aluminum absorbers were placed in front of the detector probe to gather penetration data. This data was then analyzed. The results indicate that increased atomic number metals coincide with increased penetrability of the x-rays. The conclusions were two-fold. First that it is possible to construct a versatile homemade particle accelerator. Secondly, with the specific data collected, that the "hardness" of the generated x-rays are dependant upon the strength of the Coulomb field exhibited on the orbital electrons within the target material.

#First Award - Vacuum Technology Division of the American Vacuum Society
Scholarship - Ohio State University
Second Award - United States Air Force
Third Award - General Motors ISEF

#PHONETIC ANALYSIS THROUGH COHERENT REPRESENTATION OF MEMBRANE VIBRATION

Wilcox, William E., Jr., Parkersburg H.S., Parkersburg, WV 26101;
18 Mustang Acres, Parkersburg, WV 26101.

Hypothesis: Phonetic analysis and identification of the English vowels: a. e. i. o and u may be achieved through utilization of an acousto-optic interface, consisting of a laser, acoustically sensitive membrane, reproduction equipment, and computer for voice pattern storage and formant generation. Procedure: First the subjects' vowel envelopes and frequency composition are determined. The envelope process involves reflecting the laser's beam from the membrane to a screen and making a motion picture record of the patterns resulting from subject pronunciation of the vowels and then completing frame by frame analysis through storage of pattern size. Size is directly proportional to pattern intensity at a frame's point in time. Frequency composition is determined through repeated observation of interference between the subject's vowel and the computer generated formant chord. The computer's "simulation" is gradually improved until the least amount of pattern distortion is obtained. The known formant frequencies of the computer are recorded for future comparison. Results: Envelope data is unique because no two subjects show the same envelope. The interference method provides a direct simulation of the voice. Envelope generation and frequency composition studies yielded consistent data on the subject's voice. Conclusion: The most effective means of analysis were envelope generation and frequency composition. Both methods can provide an accurate means of voice identification. Identification reliability is enhanced when both methods are used in tandem. The applications for the voice analysis methods and interface which I have designed include voice security systems, voice "Print" identification, and even aids to the hearing impared for speech production.

#Third Award - General Motors ISEF
Honorable Mention - Acoustical Society of America
Honorable Mention - American Speech-Language-Hearing Association

SQUEAKING SAND

Humble, Robin, Yarra Valley School, Kalinda Rd., Ringwood, Victoria 3134, Australia;
22 Branch Rd., N. Bayswater, Victoria 3153, Australia.

This research assignment concerns squeaking sand, which is quite rare, but occurs at several locations throughout the world. In Australia it may be found at Wilson's Promontory in Victoria, and at Bicheno on the north-east coast of Tasmania. The sand squeaks when a shearing force is applied to it, for example, by a person walking over it. Previous experimenters have established that grain size distribution, roundness and equiaxedness are important factors in the squeak. However, it is shown in this project that these qualities are insufficient in themselves to explain the phenomenon. It is suggested that something else is necessary to produce the squeak. Since most squeaking sand is composed of quartz, one possibility is the piezo-electric quality of quartz. This was first suggested by R.A. Bagnold. This suggestion was supported by demonstrating in this project that the sand squeaks whilst under fresh water, but the squeak disappears when the fresh water is replaced by a conducting fluid such as salt water.

THE OPTIMUM FREQUENCY

Larson, Nathaniel G., John Marshall H.S., Rochester, MN 55901;
2429 Viking Ct. N.W., Rochester, MN 55901.

This year I decided to work with a Tesla Coil. I chose it not because it was a Tesla Coil, but because it was a simple model of a transmitter. With this model I have been able to study about resonance, loading, coupling, impedance, and other phenomena.

This year I tried two things. First, I tried to move the operating frequency up above 1.8 MHz and second, I tried to raise the output voltage.

I wanted to raise the operating frequency because the physical size of components was smaller and because more test equipment was available. With this as my motive, I tried to move up in frequency. It did not work. The stray inductance made it impossible for the system to work as a Tesla Coil.

Later, I tried to raise the output voltage. After experimenting, almost by accident, I discovered that with a large C / L ratio in the primary, I got the most out. Now I see how the theory fits together to show this, but it was not obvious to me at the outset.

The last area that I worked with involved winding coils and predicting how much wire to use in order to hit a given frequency.

#WAVELENGTH SELECTION IN THE TUNABLE DYE LASER

Csele, Mark S., Centennial S.S., Welland, Ontario, Canada
26 Westwood Cres., Welland, Ontario, Canada, L3C 4R1

The experiment presented will investigate the factors affecting the spectral characteristics of a nitrogen laser pumped tunable dye laser. The wavelength selection system is unique as it uses a medium resolution diffraction grating instead of a high dis-ersion type usually found in this type of laser, thus a grating used alone as a wavelength selector should yield high spectral widths of the laser output. The use of intra-cavity wavelength limiters -an optical slit or filter- should reduce the spectral width to approx. one nanometer. Rhodamine 6G; 7 diethyl amino, 4 methyl coumarin; sodium fluorescein; a mixture of the two preceeding dyes; and 4 methyl umbelliferone were employed as the organic lasing dyes. Ethanol was found to produce the strongest and most stable lases. Tested concentrations varied between 5×10^{-5} m/l and 1×10^{-2} m/l. Using a 600 line/mm diffraction grating alone, spectral widths of approx. 6 nm were produced. The use of an intra-cavity optical slit between the dye cell and grating reduced the spectral width by one-half, while the use of a dielectric filter (As a Fabry-Perot interferometer) reduced the spectral width to 1.2 nm. Using five dye solutions, a continuous wavelength range from 602 nm to 392 nm can be covered. Since the wavelength range is so broad, the laser may be useful as a spectrographic emission source; however, a high dispersion grating must be used to obtain low spectral widths. Data obtained on the use of a slit or filter can be applied to a laser employing such a grating.

#First Award - American Association of Physics Teachers
First Award - General Motors ISEF
First Award - United States Air Force
Honorable Mention - Optical Society of America

BIOMECHANICAL ANALYSIS OF PRONATION

Baorto, Marisa A., North Bergen H.S., North Bergen, NJ 07047;
328 78th St., North Bergen, NJ 07047.

Pronation is the most common cause of knee injuries in runners today. It causes a patellar shift which results in damage to the medial collateral ligament. An established method for correcting pronation involves making a mold of the foot and determining the proper wedge needed to be fitted in the running shoe. This correction is not always sufficient, however, since two and one-half times the body weight is exerted through the supporting leg when running. By using a cinemagraphic technique, a more accurate correction can be determined. Runners were filmed from the front and back views, first while running with good running shoes and later while running with shoes that caused them to pronate. The film was analyzed by plotting key points in the hip, knee and ankle joints. From this, the Q-angle (the angle formed by the line of pull of the quadriceps muscle and patellar tendon) and the angle the ankle makes with the running surface was determined. (A Q-angle in excess of 20° indicates pronation.) It was found that by limiting the range of the angle made by the ankle with the running surface between 86° and 94°, the Q-angle was reduced to an optimum angle range of 10° to 15°. From this data, a proper wedge correction could be determined. By using this cinemagraphic-biomechanical technique, pronation in any subject can be accurately corrected.

#WHICH SHAPE HAS THE LOWEST DRAG IN A FLUID?

Headrick, David D., Brookfield Central H.S., Brookfield,WI 53005
14660 Golf Parkway, Brookfield,WI 53005

The purpose of my project is to determine what characteristics of a three-dimensional object give it low drag when accelerating through a resisting medium. My research had shown that drag was the resultant of the resisting force due to friction between the object and the fluid, and force due to pressure at the edge of the object.

I conducted my testing on a piece of equipment known as the linear air track, which gave me an almost friction-less plane to work on. I began my testing with five basic shapes: the sphere, ellipse, cone (base down), cone (point down), and the cylinder--all which were 15.0 grams in mass and made out of plasticine.

Each shape was tested five times falling through air and five more times falling through water. Then, I took the best results of the basic shapes and formed a second group (the elongated ellipse, tear drop, and the bullet). A total of 80 tests were carried out with over four thousand calculations performed on my computer.

My results showed that the ellipse had the lowest percentage reduction of all of the shapes, but that the "thinner" objects had the lowest drag. This seems to show that the resisting force due to pressure is more important than the force due to friction, therefore it is more important to make an object thinner than trying to lower its exposed surface area when low drag is necessary.

#Alternate Award - U.S. Department of Energy

#MEASUREMENT OF EARTH'S GRAVITATIONAL ACCELERATION AT 37 DEGREES LATITUDE

Silvertson, Eric P., York H. S., Yorktown, Va. 23692; 205 Dogwood Ct., Yorktown, Va. 23692.

This experiment accurately measured the acceleration of gravity using the period of a simple harmonic pendulum via interfacing with an Atari Personal Computer. Measured pendulum period was used to compute gravitational acceleration from the relationship: $g=4\pi^2 LT^{-2}$

A simple pendulum was set in motion. The bob interrupted an IR sensor and generated a pulse. The pulse was input to an Atari 800 computer. A machine language subroutine was developed to determine a count value for a number of independent pendulum cycles. A BASIC program was developed to control the total number of samples, to compute period from count values, to compute gravity, and to compute average period and average gravity over a total set of 35 measurements.

The computer furnished +5v power for operating the sensor detector and a separate power supply was used to activate the sensor IR emitter. The pendulum was securely mounted, and the bob was displaced approximately 5 degrees off-center. After a few oscillations to allow the simple harmonic motion to smooth, the computer program was initiated. A number of runs were made. This experiment measured an average value for the acceleration of gravity of 9.80248 m/sec*sec. This is within 0.034% of the U.S. Coast and Geodetic Survey value of the acceleration of gravity of 9.79818 m/sec*sec measured at 37 degrees 7 minutes latitude.

#Second Award - General Motors ISEF
Alternate Award - Society of Exploration Geophysicists

THE FREEZING OF HOT AND COLD WATER

Jones, Wanda R., Batesburg-Leesville H. S., Batesburg, SC 29006; Route 3, Box 84, Batesburg, SC 29006

The main purpose of my project was to find out and prove which freezes faster, hot water or cold water.

For my control I used 200 ml of boiled de-ionized water at 80°C in a 250 ml beaker which was 15.24 cm in diameter. I placed a thermometer in the center of the beaker in a frost-free freezer and recorded the temperature every ten minutes until the water was frozen. I repeated my experiments with water at 70°, 60°, 50°, 40°, 30°, 20°, and 10°C. I found that as the temperature increased, the rate of freezing time decreased.

Next, I used beakers of different sizes and different amounts of water. I repeated my experiments as I did with my control. I found that the hot water still froze faster than the colder water, but the larger the surface area, the more rapid the loss of heat.

Third, I changed the type of water used. I used boiled tap and boiled pond water. In all kinds of water, the hotter water still froze faster, but it took less time for the de-ionized water because it had less impurities.

Finally, I tested the question of evaporation. With more evaporation at higher temperatures, more mass was lost and less heat was removed from water at zero°C in order to transform the water into ice.

EFFECTS OF 2-PROPANOL CONCENTRATIONS ON CLOUD FORMATION IN A WILSON CHAMBER

O'Brien, Chris, Liberal Senior High School, Liberal, KS 67901
1401 Jerry, Liberal, KS 67901

Aqueous solutions of varying mole fractional concentrations of 2-propanol were tested in a specially modified Wilson chamber. Results indicate the mole fractional concentration of 2-propanol to be directly proportional to cloud turbidity, temperature and pressure change upon compression, and time of rainfall.

#Fourth Award - General Motors ISEF
Honorable Mention - United States Army

DETERMINING THE EFFECT OF MAGNETISM ON CRYSTALS

Willmeth, Randy G., Ralls High School, Ralls, Tx 79357
Drawer AO, Ralls, Tx 79357

The purpose of the project is to show whether or not magnetism effects the morphology of crystals. This was demonstrated by making chemical solutions and letting them crystallize on microscope slides. One set was used as a control, while two other sets were influenced by magnetic fields. These were observed under a light and projection microscope. Variation in morphologies were noted and photographs were taken of the results. Then to expose unseen difference, polarized filters were used to detect stress points and unseen morphological differences. Though all my results were qualitative, small effects on the crystals could be seen. For a more quantitative study X-Ray diffraction and electron microscopy would have to be used.

#Honorable Mention - Eastman Kodak Company

HOLOGRAPHY: ITS PRINCIPLES AND USES

Olerud, Mark D., Wahpeton Sr. High, Wahpeton, ND 58075;
814 3rd St., Wahpeton, ND 58075.

My project on holography shows the principles and uses of holography. Thru my experiments I have also shown why a laser must be used to make a holographic image rather than normal white light. I have also shown why a special holographic film must be used rather than normal photographic film. The uses I have listed are some of the latest and most commonly used in holographic technology today.

Along with an explanation of how to produce a simple transmission hologram I have given a few examples of transmission and reflection holograms.

The materials I used for my research were obtained from the North Dakota State School of Science Library. They include: Holography by H. Arthur Klien, Holography and Its Technology by John N. Butters, Holography Handbook by Fred Unterseher et.al., and the March, 1984 edition of National Geographic.

The laser used was obtained from the N.D.S.S.S. Physics Dept.

RADIATIONS EFFECT ON MICROELECTRONICS AND PROTECTING MICROELECTRONICS THROUGH DENSITY HARDENING.

Deem, Steve, Weber H.S., Ogden Utah
1191 East 3150 North North Ogden, Utah 84404

Solid state devices intended for use in applications such as space, commercial or military systems must be able to survive various types of radiation without changes in performance. The damaging types of radiation include gamma rays, flash X-rays and EMP. The purpose of this project is to test the survivability of this nation's microelectronics against radiation and protect these microelectronics through density hardening.

TEST 1: In my experiments I used RAM and ROM microchips to test and they were Out of Operation. I used a General Electric model 1000 X-ray machine and it was set at 15 milliamps and 60 to 90 kilovolts at 1/5 seconds. I designed and built a circuit to test the out of operation microchips for damage. I then bombarded some microchips, transistors and a vacuum tube, all of which were In Operation. These components were tested at 60-90 kilovolts and 15 milliamps at 1/5 to 5 seconds.

I conclude that radiation alters the atoms of the wires and renders them unconductive. Transistors and vacuum tubes survivability is greater than the chips tested, however, they can be damaged by higher dosage radiation.

TEST 2: I used high density materials to absorb the radiation (such as lead, cement, etc.). I set the X-ray machine on 1/5 second, 90 KVP, and 15 milliamps. I measured to see how much radiation passed through. I then took a one minute residue reading. I used a Geiger Counter and a Rad/hr meter.

I conclude that density elements can and will stop amounts of radiation.

#USING LASER SPECKLE TO DETECT SLOW MICROSCOPIC MOTION

Keith Hartman
Randolph High School
Huntsville, Alabama 35802
1103 Deborah Dr.
Huntsville, Alabama 35801

When a laser beam is reflected off a rough surface, it forms a pattern of bright and dark spots known as laser speckle. Since laser speckle is caused by optical interference, noticeable changes occur in a speckle pattern if anything on the target surface moves 1/2 of a wavelength of light. Using speckle, I have been able to analyze the microscopic structure of african violet leaves, measure the rate of water transport in some test plants, and detect thermal expansion in a coffee cup. Most importantly, I have been able to construct a device which uses laser speckle and an Apple computer to detect slow microscopic motion on a surface. I callibrated the device against the hands of a clock and foun that it was easily capable of detecting a motion of .34 microns per second.

#First Award - Optical Society of America
Honorable Mention - United States Air Force

SIMPLE AND COMPOUND PENDULUMS: A COMPUTER SIMULATION

Hinkle, Brent, Friona High School, Friona, TX 79035
1620 W. 10th, Friona, TX 79035

Galileo was one of the first modern men to study the motion of a pendulum. It has been said that he observed lamps swaying in a cathedral sanctuary. He found that successive vibrations of the pendulum were made in equal amounts of time, regardless of the amplitude of the vibrations. Later his observations were verified and he suggested they be used to time pulse rates of medical patients.

It is the purpose of this project to investigate some of Galileo's realizations by the aid of computer simulation. A computer can do the necessary calculations much faster and allow a deeper investigation than physical analysis alone.

A pendulum, simply defined, is an object mounted so that it can swing back and forth about an axis. A cord suspends a small dense mass called a bob. When the pendulum is resting and no motion can be observed, this point is called its point of equilibrium.

A construction which combines two pendulums of differing lengths creates a complex design for analysis. These are called Lissajous figures. Lissajous figures result from the combination of two paths perpendicular to each other with individual periods.

Computer simulation, due to its speed, flexibility, and accuracy, is quite advantageous and beneficial when analyzing pendular motion. An "ideal" pendulum can be observed with the aid of computers, eliminating friction between the bob and air. Physical restrictions limiting size and shape can be removed. Additionally, time can be saved which is lost when done manually, as long calculations are required.

SCHLIEREN OPTICS - SEEING THE INVISIBLE

Hughes, Mike R., Ardmore H.S., Ardmore, OK. 73401
246 Woods Lane East, Ardmore, OK. 73401

Schlieren optics have been known for a long time. There are many applications and uses for it. They have been used to study crystal growth, flame characteristics, magnetic fields and lenses and other optical equipment. One major use of it is to study shock waves associated with bullets, rockets and supersonic air craft. Using specialized equipment and a wind tunnel, density variations in the air around missles and aircraft can be studied.

The basic Schlieren system is really quite simple. It consists of two optical benches placed ten to twelve feet apart. On the first optical bench, a point source of light is focused, by means of a simple lens onto an optical slit of variable width. This optical slit polarizes the beam only letting vertical rays through. The light then hits a spherical mirror which reflects it (as parallel rays) to the second optical bench. The second optical bench consists of another spherical mirror to receive the rays. The image then goes through an adjustable optical knife and into a screen which filmed and converted the image onto video cassette tape by using a video camera. The test object was placed in an area between the two spherical mirrors. The test objects consisted of an alcohol lamp, a soldering iron tip and a water density experiment.

#STUDY OF THE PROPERTIES AND DISTRIBUTION OF THE GALAXIES IN THE LOCAL GROUP

Morell, Gerardo, C.R.O.E.M. High School, Mayaguez, P. R. 00709;
St. N. 81 Jardines, Arecibo, P. R. 00612.

Galaxies tend to clump and cluster together. Few galaxies are really isolated. Our own galaxy is a member of a group named the Local Group, which extends over a few megaparsecs and contains several tens of galaxies. Many astronomers doubt that the Local Group of Galaxies is in reality a bound cluster. It is possible that it could only be a group of galaxies near by chance.

This work was done to determine if the Local Group meets or not the Virial Theorem, which establishes that twice the (KE) kinetic energy average equals the (PE) potential energy average for a bound cluster. Thirty galaxies known as Local Group members until today are included. Thanks to the recent discovery of new member galaxies, this work is more complete than others made years ago.

The PE and the KE were calculated for each galaxy respect to the center of mass and the average results were compared. The 2KE to PE ratio is 4.7. It means that there exists 5 times more mass than the luminous one and that the Local Group is a bound cluster. The Local Group will continue traveling across the Universe as a whole.

Other aspects were included like the spatial distribution, volume, density, missing mass problem, type of cluster, and internal dynamics of the Local Group.

#Fourth Award - General Motors ISEF

HOLOGRAPHY - THE COMPUTER MEMORY OF THE FUTURE

Christensen, Gary E., McCluer North H.S., Florissant, MO 63033;
3945 Fairway, Florissant, MO 63033.

LONG RANGE GOAL

My project was carried out in two steps: research of lasers and holography, and applying this knowledge in a practical application.

RESEARCH

Through reading books and viewing movies, I studied theories on water waves, lenses, holography and optical holographic memories.

PROJECT

The object of my project is to store information in binary code on a film in multiple holograms and retrieve them. The holograms are read and written without moving the film. In order to do this, a lens system was used to deflect the beam to different positions on the film. To store the information, a Fourier transform hologram is made from a test data page: a photograph slide of a peg board illuminated from behind with selected holes covered to present a binary code. A five degree of freedom stand was built for each lens, mirror and beam splitter to achieve precision alignment. Each stand was fastened to a base plate to reduce effects of movement and vibration. To analyze the quality of the data retrieval system studies were made of the error sources including: noise, contrast, and lens distortion. The end product is a data storage system without moving the recording medium to produce an optical holographic computer memory.

#Third Award - General Motors ISEF
Honorable Mention - Optical Society of America

#SOLAR HOT WATER HEATERS: AN ANALYSIS OF VARIOUS TUBE TYPES

Knepper, Terry J., Captain Shreve High School, Shreveport, LA 71105
1820 East Kings Highway # 21, Shreveport, LA 71105

Solar hot water heaters are a possible solution in reducing the world's fuel shortage. Toward this end, an analysis of tubing material available to manufacturers was tested for their ability to heat water in the shortest time span. A determination of the best tube type would increase the efficiency of solar hot water heaters.

The purpose of this research is to analyze 1/2" tubing: (L)copper; (K)copper; steel; schedule 20 PVC; schedule 40 PVC; and schedule 80 PVC, to determine which material absorbs radiant energy in the shortest time span and produces the hottest water.

Each tube type was filled with 21°C water and was exposed to a controlled heat source for five, ten and fifteen minute time intervals. Temperatures were recorded and chi square analysis was used to determine significant differences in temperature; t-Test was run comparing (L)copper, the tube type currently used in solar hot water heaters, to all tube types to determine significant differences. The tests were repeated and analyzed as stated.

Results to date indicate no significant difference in temperature exists between the test groups of tubes at five, ten and fifteen minute time intervals and no significant difference exists between (L)copper and the other tubular materials treated in these tests. It should be noted that (L)copper and steel varied in water temperature at the end of the fifteen time interval by 13°C in treatment 1 and by 10°C in treatment 2.

#Honorable Mention - National Aeronautics and Space Administration

THE ELECTRICAL CHARACTERIZATION OF POLYCRYSTALLINE SILICON

Alford, Ron C., Pine Forest H.S., Pensacola, FL 32506
3257 Donley Street, Pensacola, FL 32506

Today's electronics industry is a very competitive field where a slight technical advantage can make or break a company. These companies are currently trying to utilize polycrystalline silicon in their circuits, primarily because it will lower their overall production costs. It is quite difficult to use polysilicon since its electrical properties are not well understood. In particular polysilicon, like other semiconductors, has the property of negative temperature coefficient of resistance (-TCR). In other words, as the temperature of the polysilicon rises, the resistance of the material falls drastically. This obviously causes substantial problems for the design engineer who is interested in utilizing polycrystalline silicon in his circuits. This author's research is a small part of a large program involving the University of Florida Department of Electrical Engineering and the Harris Semiconductor Corporation (Melbourne, Florida) aimed at understanding in detail the electrical properties of polycrystalline silicon. The author performed the Hall Effect experiment which provides resistivity, mobility, and carrier density measurements on a small set of polycrystalline silicon devices. The important result of this research is that the TCR becomes more positive (resistance rising as temperature rises) at high doping concentrations and high laser annealing temperatures. This indicates that a region of ZERO TCR (resistance constant with temperature) does exist. This result will be useful when included in the large program currently in progress at the University of Florida.

#THE INERTIAL-CONFINEMENT REACTOR CONCEPT

Shively, Chris S., Caddo Magnet H.S., Shreveport, LA 71101;
8824 St. Clair, Shreveport, LA 71118.

In the inertial-confinement reactor concept, plasma heating energy in the form of ion beams are delivered to a fuel pellet in about one nanosecond within a cavity surrounded by a blanket. The purpose of this project is to prove the validity of the inertial-confinement reactor concept, or more commonly known as an ion engine, as a space thruster.

The idea of using accelerated ions as a thruster for space vechicles only works in a vacuum enviroment, because the miniscule starting thrust is less than the molecular resistance at the opposite end. In an ion engine we have a positive exciter, the anode, in which mercury vapor, the fuel source because of its high density, collides with the exciter and changes the overall valence to a positive one. The ionized mercury atom then races over to a strong negatively charged magnetic field and picks up an electron, thus neutralizing the ion. The thrust can be indirectly measured by attaching a mirror to the engine and bouncing a helium/neon laser of it and calculating the angle between vectors. The angle between vectors was a mere 0.01 degree. A more direct way to figure out the thrust would be to use the formulas $F=\frac{1}{2}mv^2$, $F=ma$, and $V=V_0+(At)$. After the required substitution, we find the acceleration to be 1.352×10^{-3} m/sec^2.

In conclusion, electron bombardment ion thrusters may be employed for altitude control and station-keeping of earth synchronous satellites, and perhaps for other purposes in maneuvering satellites.

#Honorable Mention - National Aeronautics and Space Administration

#EUREKA! A NOVEL METHOD FOR MEASURING GAS MOLECULAR WEIGHT

Lee, Shih-Chuan, Taiwan Provincial Tainan Second H.S., Tainan, Taiwan
15, Lane 1, Chung Kung Rd., Kang Shan Li, Kaohsiung Hsien, Taiwan,
Republic of China, 820

PURPOSE: To design a simple but reliable method to measure the gas molar weight (and density of gases) by using a simple equipment and the physics familiar to middle school students.
PROCEDURES: A device composed of a microbalance (straw balance) and an optical lever, is built to detect minute changes in buoyancy due to air (or any chosen standard) and a mixed gas of air and sample gas, on a solid rectangular of known volume.
First, check the position of the balance pointer then replace half of the air by the sample gas. Followed by adjusting the pressure in the container, the original position of the pointer is resumed (null.) The pressure difference is then measured which gives the density of gas and hence the molar weight.
CONCLUSION: a) In this experiment the gas molar weight can be determined to 10^{-3} gram. b) The accuracy can be improved by using a precision manometer. c) Measurement can be done at a reduced gas pressure so that the ideal gas law can be applied to a larger extent.
APPLICATIONS: a) A precision equipment based on the principle used in this research can be made. b) Our equipment is a good teaching aid in demonstrating the related physics concept such as the buoyancy of gas ... etc. Furthermore our method will make students familiar with basic experimental techniques.

#First Award - General Motors ISEF
First Award - Gulf Oil Corporation
Second Award - American Association of Physics Teachers

#INTERFERENCE

Ploets, Wolfram, St. Paul's Episcopal School, Mobile, AL 36690
108 Claridge Rd. W., Mobile, AL 36608

The purpose of this project is to study how two different frequencies interact by interference to produce a third frequency.

Since two waves reinforce each other when in phase (constructive interference) and cancel one another when 180° out of phase (destructive interference), it can be shown graphically that two different frequencies will periodically cancel and reinforce each other. Thus, it can be hypothesized that this variance in intensity should constitute a third frequency.

A computer that could generate two sounds simultaneously with reasonable accuracy was used. The audio signal was fed into an oscilloscope and, via an amplifier, into a speaker and an audio level meter. The computer then generated various pairs of frequencies.

Using 111.0 and 111.1 Hz, the meter registered a high and low level (one complete cycle) every 10 seconds. At each low level (node) there was a point where no sound was heard. The oscilloscope showed how the waves apparently moved past one another and how the resultant pulses became bigger and then smaller. Thus, a beat frequency was audible with a difference of 0.1 Hz.

It was found in further trials that any two frequencies always interfere to produce an apparent third frequency equal to their difference.

#Honorable Mention - Acoustical Society of America

CAUSTICS: OPTICAL FUNCTIONS GENERATED BY LIGHT REFRACTION

Werner, Martin, Opp High School, Opp, AL 36467;
305 E. Park Ave., Opp, AL 36467.

Caustics, by definition, pertain to or designate "the envelope of rays emanating from a point, reflected or refracted by a curved surface." From irregularities in the surface originate basic elements of caustic curves, called point and cusp catastrophes, which form in conjunction with other patterns to create specific kinds of curves.

The curves, after they were captured on film, were then analyzed in numerous ways. In order to ensure the accuracy of the experimental data, comparison to known varieties of catastrophes was essential. To further identify and define caustics, the curves were likened to those produced using varying substances as alternate mediums for light refraction.

Since the curves produced are sometimes a distinguishing characteristic of the substance being tested, caustics could quite conceivably be utilized in material design. Although the use of catastrophes in various other fields is still speculative, caustics definitely hold many unanswered questions and unique oportunities for further research.

WHY HOT WATER PIPES FREEZE FIRST-OR DO THEY?

Johnson, Scott L., Afton H.S., Afton, OK 74331;
Route 1, Box 12, Afton, OK 74331.

The purpose of this project is to determine if hot water will freeze before cold water and if possible which pipes would freeze first.

My hypothesis is that cold water will freeze before hot water because to lower the temperature of each to the freezing point more calories of heat must be removed from the hot water than from the cold water.

I experimented using one can of hot tap water and one can of cold tap water. These were put outside when the air temperature was -11°C. The temperature was measured at 5 minute intervals until the water had a solid layer of ice on top. The results were that the cold water froze nearly an hour sooner than the hot water.

Even though cold water freezes before hot water there are several reasons that the hot water pipes might freeze before the cold water pipes. Convection currents transfer heat from the ground up the cold water pipes but hot water pipes aren't underground. Cold water pipes are used much more than the hot, thus hot water pipes have more time to cool down.

My experiment proved cold water freezes faster than hot and my theory is hot water pipes freeze faster than cold water pipes according to the evidence under the conditions tested.

#THE USE OF MASS SPECTROMETRY TO MEASURE THE BY-PRODUCT PRODUCTION OF D_2O FROM A SYNTHETIC FUEL PLANT

Herring, Marc A., Benjamin E. Mays High/Academy, Atlanta, GA.30331; 3390 Fairburn Rd., SW, Atlanta, GA. 30331.

Heavy water (D_2O) is a form of water in which the H_2 atoms of 1(H) ordinary present in water are reduced by deuterium (the heavy stable isotopoe of H_2 of mass 2.) Deuterium is present in ordinary water to the extent of 0.0145%. Water is the only practical source of deuterium and very large amounts of water must be processed to produce relatively small amounts of D_2O. Heavy water is of great value in the nuclear industries serving as a moderator and coolant in power reactors. Heavy water produced in the United States by the GS process (a process used by all heavy-water plants in producing 20 metric tons of D_2O) is priced at $220/kg in bulk quantities. Knowing this, I was curious to research possible ways in producing D_2O at an inexpensive rate.

I started my project with the idea of producing the synthetic fuel gases CO and H_2 by passing steam over a red hot bed of coke, thus obtaining D_2O. The deuterium present in normal water did not react with the coke at a rate of 16%. Knowing this I refluxed the unreacted steam 24 hrs./day for 5 days. To measure the enrichment of D_2O a mass spectrometer was used. The data obtained shows that this process is significant.

I thus conclude, that this synthetic fuel reaction produces low-enrichment D_2O which can be enriched to a usable state very inexpensively.

#Fourth Award - General Motors ISEF

#THE EFFECTS OF FILM COMPOSITION ON MOSFET PERFORMANCE

Wiltshire, M. Daniel, Canton H.S., Canton, MO 63435
1511 S. Monticello Road Canton, MO 63435

The purpose of this project was to compare the performance of various metal oxide films in metal oxide semiconductor field effect transistors. The metal oxide films were produced by dissolving 1 gram of a filtered metal resinate precipitate in 50 ml of turpentine and applying either a single resinate or two resinates in ratio to a glass slide. Sulfur vapor was added through a vapor phase displacement reaction to form a semiconductor from the oxide film. Two strips of silver paste for the source and drain electrode, a layer of insulation and a layer of silver paste for the gate electrode completed the transistor.

The procedure was repeated with iron and manganese singly and in ratios of 1:1, 1:2, 2:1, 1:4, and 4:1. The transistor's performance was tested in 3 circuits and was measured with a microammeter. The effectiveness of the films was evaluated by a comparison of transistor characteristics. There was a total of 100 single film transistors and 250 mixed film transistors made for this study.

In conclusion, the 1:2 ratio of iron to manganese is the best semiconductor out of those tested in this experiment. The 2:1 and 1:1 ratios are better than manganese singly, and all of the ratios and the single manganese semiconductors are better than iron by itself when installed in homemade MOSFETs. The mixing of iron and manganese semiconductors to reduce cost while maintaining performance is recommended in low ratios, found to be 1:2, 2:1, and 1:1 in this experiment.

#Fourth Award - General Motors ISEF

KIRLIAN PHOTOGRAPHY: IS THERE AN ANSWER TO ITS MYSTERIES?

Myers, Mark T., Central High School
Davenport, IA 52803
1515 Jersey Ridge Road, Davenport, IA 52803

Kirlian Photography, High Voltage Photography, has long been though of as an indicator of the psychic aura of a living being; but there has been no agreement on an explanation of what cuases the effect. The purpose of this research was to try and find, by experimentation, a plausible explanation of why this aura forms around an object when a high voltage current is passed through it and if there are any possible uses for it.

Testing was done on pennies of different years to see if there was a variance in the image of solid copper pennies and zinc cored pennies, and on salts of various hydrations to see if one could find a difference in the image. The results of the testing done on the pennies was inconclusive with no repetitive patterns showing up in the images, while the tests on the salts showed good results with a definite difference showing up between the images of the various water amounts. After experimenting with different objects (plants, coins, water, etc.) at both normal and low pressure, the conclusion reached about the cause of the effect is that the image produced on film is a measure of the conductivity of an object. The energy flows through the object, subject to its variances in conductivity, and then excites the electrons in the surrounding air, thus causing the blue aura. The major use discovered is that Kirlian Photography can be used to find the relative water content of two objects without destroying them like dehydrating them would do.

ZOOLOGY

#A Study Of The Radioprotective Effects Of Acetylcysteine in Drosophila Melanogaster

Rusche,Kritin M., Evansville,Indiana 47715, Reitz Memorial H.S. 802 Wiltshire, Evansville Indiana 47715

I prepared five cultures of wild-type fruit flies. One was a control group with normal media. The others had varying concentrations(3.6% !.8%, 0.9%, 0.036%) of N-acetylcsteine (NAC) added to the media. Wild type fruit flies were placed in all of vials.

One hundred and fifty third-instar larvae that were close to pupating, were removed from each vial. Within two hours after removal the larvae were given 300 rads of radiation (cobalt-60). (The time is crucial because NAC moves out of the system quickly). After irradiation, all the larvae were placed in vials containing normal media with no concentration of NAC. Approximately a week later, all flies that survived to adulthood were counted and their eyes, wings, and body color were examined for abnormalities. All flies that hatched were accounted for. There was no time limit.

#Second Award - General Motors ISEF
Alternate to Scholarship - Ohio State University

ASPECTS ON THE BIOLOGY OF AMEIVA EXSUL (Cope) in SOUTHWESTERN PUERTO RICO

Santana, Edwardo A., Dr. Pedro Perea Fajardo H.S., Mayaguez, P.R. 00709; Reparto Universitario Calle 4L-22, San Germán, P. R. 00753.

The lizard Ameiva exsul Cope, the common "iguana or siguana" of the Caribbean, is one of the most abundant and less known literally of the reptilian fauna of Puerto Rico. This study is an attempt to improve our knowledge on mainly two aspects on the biology of this organism, its food habits and the parasites that attack this form in the island.

Sixteen stations were chosen for this study. The environmental parameters were determined for the place where the "iguanas" live. A total of 135 lizards were collected and examined for external as well as internal parasites. The incidence of infection was one of 37%. A total of 492 parasites were found. Of the parasites found 5.2% were mites, 50% were cestodes, 8.7% were nematodes of species A, 11.7% were nematodes of species B, 7.1% were nematodes of species C and 17.3% were trematodes.

The diet of A. exsul was found to consist of crickets, ants, roaches and other insects. A good determination was not possible since most organisms collected from the field had bread in their stomachs.

RESEARCH OF FROGS - SPAWNING, DEVELOPMENT AND THEIR ENVIRONMENTAL CONDITIONS -

Hasegawa, Hiroko, Hamamatsu H.S., Hamamatsu, 432;
379 Oyanagi-cho, Oyanagi-shi, Shizuoka 430, Japan

Having done research on ranids (Rana japonica), indigenous to Japan, and toads (Bufo bufo japonica), familiar all over the world, I've reached the following conclusion. From the 10th day until the 20th day of February, ranids lay eggs when the temperature rises suddenly. This always takes place where DO value and water temperature are constant. On the other hand, toads lay eggs after it rains from late February through early March. They lay eggs in still water, regardless of water temperature. The jelly-like coating surrounding an egg, which is unlikely to conduct heat, prevents evaporation of water and protects the egg from captors. The stage of Metamorphosis: About forty days after an egg is laid, hind-limbs begin appearing and approximately fifty-four days later, the differenciation of the toes is completed. Simultaneously, fore-limbs are formed. Their bone structure is formed in the branchial cavity. As for ranids, about sixty-five days later, their right fore-limb comes out of the branchiostegite ahead of the left one. The growth graph of hind-limbs and toes makes a logistic curve, and is remarkable around the time of differentation of the toes. The caudal of a tadpole begins to be absorbed about seventy days after an egg is laid, when both fore-limbs have developed. The metamorphosis is completed about a hundred days after an egg is laid. About six-sevenths of the intestines of a tadpole degenerate before completion of metamorphosis.

#THE CLIMBING ABILITY OF COCKROACHES

Constable, Anne, Queen Anne's School, Caversham, Reading, Berks RG4 0EX
102 Kings Road, Berkhamsted, Herts. HP4 3BP

The ability of various species of insect to climb smooth vertical surfaces has puzzled scientists for many years. Several hypotheses have been advanced but lack experimental proof and the subject remains controversial among experts.

In this project the feasibility of each hypothesis was investigated experimentally, using three species of cockroach. Some theories were readily disproved by experiment, eg. those associated with suction, electrostatic attraction and surface tension. A complex series of tests was then devised to evaluate the remaining hypotheses, eg. those associated with gripping by claws, secreting an adhesive and long range intermolecular forces of the 'van der waals' type. Analysis of the results indicated clearly that cockroaches climb by secreting on adhesive, which is probably organic in nature and similar to the grease known to be secreted elsewhere on the cockroach body.

Before accepting the adhesive theory, it was necessary to determine whether any traces of this adhesive remained on a surface and also to explain how the tarsi are detached. Novel research methods were developed to investigate these points. Fine amorphous aluminium powder disclosed very slight traces of adhesive which were otherwise invisible, even using staining techniques. Examining the tracks left by cockroach tarsi on smoked glass indicated that the tarsi are detached by the claws flexing/extending.

Evidence that the adhesive is secreted by the arolium and euplantulae, which are frequently cleaned by the cockroach, has a bearing on methods of exposing cockroaches to insecticides.

#First Award - Eastman Kodak Company
First Award - Entomological Society of America
Third Award - General Motors ISEF

THE TERATOGENIC EFFECTS CAUSED BY ALCOHOL ON RAT OFFSPRING

Miranda-Albino, José R., Emilio R. Delgado H.S., Corozal, PR 00643
Box 928, Corozal, PR 00643

The different gradations of alcohol applicated to rats (Mus-musculus) will cause congenital malformations (teratogenicity) to its offspring.

This experiment consists in determining the damage that causes alcohol to the future offspring of the Mus-musculus that is to be born. The reason that motivated me to do this experiment was watching how so many pregnant women make use of alcohol without knowing the damage that this will cause to the future child. The different gradations of alcohol fed to rats (Mus-musculus) will cause congenital malformations (teratogenicity) to its offspring. The Mus-musculus were distributed in eight different cages. Two of the rats were administered water and food, and the rest of them different gradations of alcohol. This is the first part of the experiment in which the Mus-musculus are alcoholized. In the second part the female to which water, wine and food was administered produced three deformed rats. Approximately three hours later she ate them. The types of deformity were: (a) Mus-musculus without tail; (b) without back legs; (c) completely deformed.

The rest of the Mus-musculus did not reproduce because the alcohol affected their sexual organs. In the females the ovary and uterus were affected. It damaged its ovulation. In the males the production of sperm was affected. Abnormality seen in the sperm: (a) sperm with double head, (b) sperm without tail, (c) sperm without head, (d) sperm with double tail, (e) decrease of sperm in number by c.c.

#Honorable Mention - United States Air Force

INSULIN TOLERANCE IN CARASSIUS AURATUS AS RELATED TO TEMPERATURE

Chiasson, Jennifer Ann, Walker H. S., Walker, LA. 70785
29439 Magnolia Drive, Walker, LA. 70785

Experimental goldfish, Carassius auratus were used in observing the symptoms of insulin shock and the effect of temperature variance upon insulin tolerance. This experiment consisted of two phases in which observations and data were gathered.

Throughout the experiment, variables such as diet, fish size, and temperature were standardized. In the first phase of the experiment, using several fish as controls, experimental goldfish were placed in a holding tank with pre-calculated dosages of insulin. The experimenter recorded the fish reaction and the time between the onset of the symptoms of insulin shock. The observations and data were used to determine a standard solution for the second phase of the experiment.

During phase two of the experiment, a standard dosage of insulin was used and temperature served as a variable. The temperature range was obtained through the use of hot and cold water baths and did not exceed normal functioning criteria for goldfish. Through phase two of the experiment, the effects of temperature on insulin metabolism were observed. The observations and data in turn were analyzed and recorded.

As a result of the data it can be concluded that a direct relationship exists between temperature and insulin tolerance. The basic information and techniques acquired throughout this project can be modified to include the comparative study of a variety of animal species. Perhaps further investigation of insulin shock should be made varying PH and other physical factors as variables. Eventually this research can be utilized to better understand insulin metabolism in man.

#Honorable Mention - Eastman Kodak Company

BIOLOGICAL AND ECOLOGICAL STUDY OF NASUTITERMES COSTALIS AND ITS CONTROL USING EXTRACTS OF SEVERAL PLANTS IN SOUTHWEST PUERTO RICO.

Sánchez, José A., Lola R. de Tio High School, San Germán, P.R. 00753; Bo. Guamá, Box 215, San Germán, P.R. 00753.

Nasutitermes costalis, a plague whose life cycle depends on the cellulose of trees, is one of Puerto Rico's most common causes of the destruction of trees. Mankind has taken measures to prevent the growth of this plague by buying wood that is chemically treated and also by using chemicals on trees to exterminate the plague. These measures are ineffective because the chemicals damage the trees and its crops as well as contaminate our waterways and our Earth.

This shows that mankind has the necessity of finding new control agents that do not affect ecologically the area being treated. For this reason, this project tries to find a new way to control Nasutitermes costalis using the least chemicals possible and using natural substances produced by plants. The use of methanol in this study is to make possible the extraction of the substances without affecting their effectivity.

The results obtained from the plants Datura suaveolens, Datura mollis, Solanum torvum, Solanum dulcamara, Physalis alkenkengi and Datura metel reduced Nasutitermes costalis in 75% without affecting the trees' life style or its crops.

In the Southwest Region of Puerto Rico, the control of the plague is higher, due to its high temperatures and low rainfall. In the Northwest Region, due to its high rainfall and low temperature, the control is lower.

CONTROL OF GASTROPHILUS INTESTINALIS USING CHEMICAL PREPARATIONS AND BIOCHEMICAL CATALYSTS

Guffey, Andrea, Weber H.S., Ogden, UT 84404 3179 N. 1000 W. Ogden, Utah 84404

The bot fly, Gastrophilus intestinalis is an arthropod, but also an internal parasite of the horse population. The adult fly lays small yellow eggs on the forelegs of the host. When licked, the eggs are stimulated to hatch and then burrow into the tongue. The larvae then migrate to the stomach and attach to the stomach lining. It is here that the bot does its greatest damage; causing malnutrition, colic, and even death!

Combat of the bot cycle has been a problem for horsemen through the centuries, and many chemicals have been developed to destroy the larvae once they have attached to the stomach wall. This can become a risky and laborious process, so why not break the bot cycle before it enters the internal working of the horse? This is the problem upon which my project is based, and I have approached this problem from a unique angle; that of biochemical degredation of the bot egg encasement.

Having intentions of using the biochemical enzyme 'chitinase' (which is found in the molting fluids of insects, and degrades only chitin), I first tested the eggs for the presence of chitin. After receiving positive results, I then administered the chitinase solution to the eggs, mixed in a 10% saline solution. After a 2 hour transaction period, I examined the eggs under magnification, and bands of chitin had been totally degraded! This loss of chitin bands exposed the larvae to the atmosphere and they were non-viable after treatment. If used commercially, this would be a very convenient and effective method of bot destruction. It would have a astronomical affect on the horse and veterinary industry.

#First Award - American Veterinary Medical Association
First Award and Alternate to London International Youth Science Fortnight - United States Navy/Office of Naval Research
Second Award - General Motors ISEF

THE EFFECTS OF PETROLEUM MUDS ON THE OLFACTORY SENSE OF ZEBRAFISH

De Armas, Mike, A&M Consolidated H.S., College Sta., Tx. 77840;
Rt. 5 Box 1402, College Station, Texas 77840.

Petroleum products and drilling by-products are known to be toxic to a wide range of animals. But, little is known of the sub-lethal effects of drilling muds on fish. The effects of these fluids on the chemobehavior of Zebrafish (Brachydanio rerio) were tested in a 2-choice maze. Controls (with no chemicals) showed no left or right bias. L-Alanine (an amino acid) infused at $1x10^{-3}$M was highly attractive. Drilling fluid infused at 1 ppt generally showed repulsion. After exposing the fish to a 1 ppt solution of drilling mud, the fish showed a marked decrease in their positive response toward L-Alanine. It may be concluded that exposure to drilling mud has a marked inhibitory effect on the olfactory orientation of Zebrafish.

EFFECTS OF OUTBOARD MOTOR EXHAUST ON SELECTED MARINE ORGANISMS

Gann, Melissa E., E.D. White Catholic H.S., Thibodaux, LA 70301
431 Easy Street, Thibodaux, LA 70301

This project is a study of the effects of outboard motor exhaust water on three marine organisms. The organisms chosen for this study were the ciliate protozoan, Tetrahymena pyreformis, the fresh water grass shrimp, Palaemonetes sp, and the Japanese Medaka, Oryzias latipes.

The standard static bioassay test tube technique was used with Tetrahymena pyreformis. Growth was measured gravimetrically. By interpolation, the effective concentration, 50 per cent, was found to be 2.2 per cent exhaust water.

The effect on Palaemonetes was determined by means of a flow-through bioassay technique. The lethal dose, 50 per cent, was found to be 0.59 per cent.

Oryzias latipes eggs were used rather than adults. The effects of exhaust water on egg hatchability and fry survival after embryo exposure were observed. It was found that exposure to exhaust water in the 1-3 per cent range increased incubation time and decreased hatchability. The survival rate of fry which had been exposed to exhaust water as embryos was reduced.

#CLONING OF MOUSE EMBRYOS BY SEPARATION OF BLASTOMERES

Parker, Paige Karen, Oregon Episcopal School, Portland, OR 97223
2288 SW Humphrey Park Road, Portland OR 97221

No abstract received.

#Third Award - General Motors ISEF

TO DETERMINE THE VALUE OF THE BARN OWL TO THE FARMER

Doyle, Jamie, West. Alb. H.S., Charlottesville, VA 22901
1580 West Pines Drive 22901

My problem was to determine the value of the Barn Owl to the farmer. Throughout its existence, the Barn Owl has been tagged as a mysterious and menacing creature. From my knowledge of the Barn Owl and its habits, I hypothesized that the Barn Owl is not a destructive creature but one that actually helps the farmer. If I could prove this to be true, I would have a project with which I might educate the public. If the Barn Owl did prove to be a culprit, I might find a way to help the farmer yet preserve the Barn Owl species.

The first part of the procedure was to determine what prey species enter the diet of the Barn Owl. I collected the skulls found in Barn Owl pellets. The second part of the procedure involved making calculations based on my findings and interview information. The calculations would show how much money one Barn Owl might save a farmer in its lifespan. The pellets I collected yielded sixty rodent skulls and none fo any other organism. In my calculations I found that in a Barn Owl's lifetime, one Barn Owl might save a farmer approximately $200,000.

From these results I can conclude that the diet of the Barn Owl consists mainly of rodents, thus excluding the farmer's poultry. My calculations show that the Barn Owl actually aids the farmer by eating destructive rodents, therefore saving him a rather large amount of money.

#THE EFFECT COLORED AND ULTRAVIOLET LIGHT HAS ON THE WEIGHT AND REPRODUCTIVE FUNCTION OF THE MUS MUSCULUS ALBINA.

White, Rana, MacArthur H.S., Lawton, Ok. 73501
415 N.E. 46th Street, Lawton, Ok. 73501

This experiment was initiated to examine whether colored and ultraviolet light has an affect on the weight and birth of offspring of mice. Forty-eight CFI white mice were placed in cages with a ratio of three females to one male for a total of six female mice under each light. The mice were weighed three times a week. An accurate number of pups was recorded from each litter hourly while the mice were giving birth. The cages were contained in a white apparatus built to make all 100 watt light intensities equal.

The females were then acclimated under the colored and ultraviolet lights from 12 a.m. to 12 p.m. for two weeks. The same males were introduced to the initial set of females. The colors of the lights were blue, green, red, yellow, white and ultraviolet. The offspring were counted and again weighed thrice weekly. The results were tabulated and a conclusion was derived. The conclusion was that the wavelength of the light had a direct effect on the weight. PMSG, a fertility drug, was given to the mice under the red light in an attempt to reverse the results achieved by the light.

The weight order of the mice was blue, green, yellow, red, white, and ultraviolet. The greater number of offspring was from most to least blue, ultraviolet, green, yellow, white, and red. The order of the length of pregnancy was red, blue, green, yellow, white and ultraviolet.

The results showed many different things. These results are beneficial to mankind. These facts can be incorporated into everyday life and help man in his technical advancements for his benefit for a better life in the future.

#Second Award - General Motors ISEF
Second Award - United States Air Force

#A TWO YEAR STUDY OF THE GENETIC EFFECTS OF RADIATION ON DROSOPHILA MELANOGASTER

Serra, Fernando G., South Sumter H. S., Bushnell, Florida 33513
303 E. Dade Street, Bushnell, Florida 33513

Last year I radiated D. melanogaster with microwave radiation. This year I radiated the fruit flies with ultraviolet radiation. Since mutations occurred from exposure to microwaves, I felt that the ultraviolet radiation will also cause mutations. I formed four groups of flies. Group 1 contained exposed males and unexposed females. Group 2 contained exposed females and unexposed males. Group 3 contained both exposed males and females. Group 4 was the control group. Every other day for 10 days, the flies were anestisized and observed under a stereomicroscope. This was continued until the F_4 generations were observed. In my P_1 and F_1 generations, no mutations were observed. In the F_2 generations, groups 1, 2, and 4 remained the same, but the third group (exposed males and females) showed a white body color and a right wing mutation. In the F_4 generation only group 3 exhibited mutations again. Four mutations were observed. There were flies with white body color, right wing mutations, both wings mutated, and a white body color with no wings and an altered abdominal structure. I conclude that ultraviolet radiation does cause mutations in D. melanogaster, but only if both males and females are exposed to the ultraviolet light. Since ultraviolet light causes genetic changes in D. melanogaster, we should be aware of the thin ozone layer in our atmosphere which protects us from ultraviolet radiation from space. This diminishing layer is deteriorating rapidly from chemical reactions with nitrogen compounds and fluorocarbons. We should also be aware of the increase in high-frequency radiation in our environment from televisions, microwave ovens, and X-ray machines.

#Fourth Award - General Motors ISEF

#HOW SHOULD IRON BE INJECTED IN SWINE

Richtsmeier, Dean J., Clifford-Galesburg H.S., Galesburg, ND 58035
Galesburg, ND 58035

Iron has to be injected in newborn pigs because in modern hog raising facilities, newborn pigs do not come in contact with soil. In their natural habitat, the soil would supply them with the needed iron. I decided to see which injection would be better—subcutaneous or intermuscular. I took a litter and gave half the pigs an intermuscular injection and half the pigs a subcutaneous injection at one day and one week of age. I weighed and drew blood at one day, one week, two weeks, and three weeks of age. The blood was then taken to North Dakota State University to be tested for hemoglobin levels and percent of hematocrits. The intermuscular injection produced a heavier pig because they grew faster in the first week. The iron was absorbed right away because there is more blood flow to the muscle than the skin. The subcutaneous injection produced a pig that grew faster in the second and third weeks. The iron was not absorbed fast enough in the first week; therefore, the pig didn't grow as fast. Because it was absorbed over a long period of time, it alos produced higher hemoglobin levels and higher percent of hematocrits. I then did another test, where half the litter was given both an intermuscular and subcutaneous injection; the other half were given an intermuscular injection at one day and one week of age. The pigs that were given both types of injection were given 800 mg of iron and the pigs that were given an intermuscular injection were given 400 mg. This added iron would cost about 15¢. The pigs that were given twice as much iron grew about 1.5 pounds more in three weeks. Even with the added iron cost, in a 100 sow herd you would recieve a profit of 600 dollars by giving twice as much iron, injected by both types of injection.

#First Award - American Veterinary Medical Association
Third Award - General Motors ISEF

THE ANTHILL

Chappell, Alex G., Wayne High School, Bicknell, Utah 84715
Box 1383, Lyman, Utah 84749

The purpose of this experiment has been: to see if ants poison the soil to prevent plant growth; to find the dimensions of anthills; to see the amount of land taken up by hills; and to find if the sun affects the dimensions of the hill.

In this project four soil samples were collected at graduated distances from an anthill. Bean seeds were planted in the samples. Seeds planted in soil from the center of the anthill sprouted and grew. Seeds planted in soils from 1, 2, and 3 feet away failed to sprout.

Further studies indicate that the ants allow plants to send root systems throughout the hill which protects it from erosion, while no plants even begin to grow in the cleared space around the hill called the courtyard. After the plants on the hill have grown, the ants strip them of their leaves, killing them. It has been found that repeated watering of the soil seems to leach out any chemicals the ants may have secreted into the soil.

Another experiment was performed to see if ants build slopes toward light sources since it has been found that the hills have slopes elongated toward the west. The probable reason for this is that by the time the ground has warmed up enough for the ants to start working, the sun is nearly overhead and starting to move westward.

To test this hypothesis two containers with ants were placed in a position where one received predominantly morning sunlight and one received afternoon sunlight. The ants were observed carrying small rocks and soil particles toward the sunlight but they would not work toward an artificial light. This could mean that they can sense ultraviolet radiation or work toward the heat. Slopes were created but because of the glass barrier they took a different form than they would in the outdoors.

SENSITIZATION AND HISTAMINE RELEASE BY CELLS OF A PROMITIVE ANIMAL, THE SAND DOLLAR, MELLITA QUINQUIESPERFORRATA

Smith, Shana L., Buchholz High School, Gainesville, FL, 32605, 3915 S.W. 78th St., Gainesville, FL 32608

The coelomic fluid of the sand dollar, Mellita quinquiesperforrata, contains coelomocytes, cells that release red pigment granules when stressed and which have been found to aid the animal in neutralizing many types of stress. The releasing action of the coelomocytes is comparable to the mast cells and basophils of humans, which release histamine and other substances when sensitized during an allergic reaction. The possibilities were tested that (a) the coelomocytes of the sand dollar could become sensitized, through two applications of stress and observing for the release of pigment granules, and (b) histamine might be released, determined by a standard histamine assay after each dose of stress was applied. The sand dollar coelomocytes were found to contain histamine and do become sensitized, although histamine release does not follow the human sensitization pattern and is disproportionate to red granule release. These findings would suggest that the cell mechanism of the sand dollar, situated as a member of the echinoderm phylum on the evolutionary route to man, may be a precursor to the human allergy mechanism.

LOCALIZATION OF LAMININ IN THE BASAL MEMBRANE OF THE CHICK CORNEA

Blinkow, Andrew, Anderson High, Austin, Texas 78759;
8100 Balcones #224, Austin, Texas 78759.

Immunoflourescent studies of the basal membrane of several embryonic tissues indicate the presence of laminin. The exact role of this protein is unknown, but it is thought to act as an attachment molecule. This study attempts to test the attachment hypothesis by examining both basement membrane surfaces for the presence of laminin.

The epithelial layer of five day old chick corneas was peeled off in two ways to expose the basement membrane epithelial surface and the matrix surface. The membrane surfaces were treated with rabbit anti-mouse laminin antibody followed by sheep anti-rabbit IgG linked to immunolatex microspheres and processed for Scanning Electron Microscopy. Upon examining both surfaces of the basement membrane, the epithelial surface was heavily tagged with spheres, whereas the matrix surface was beadless. The distribution of the spheres on the epithelial surface was uneven forming streaks and patchy clusters. These results suggest that laminin is found only on the epithelial surface of the basement membrane. Control specimens treated with pre-immune rabbit IgG and latex spheres alone were negative. The results are consistent with the hypothesis that laminin serves to attach the epithelial cells to the basal membrane.

#Honorable Mention - Eastman Kodak Company

FINGERPRINTS: MAN'S PERMANENT I.D.

Cunningham, Kari B., Sheridan H.S., Sheridan, AR 72150
Route 4, Box 1449, Little Rock, AR 72206.

The student did this project to determine the percentages of occurrence of the different types of prints, to see the familial differences, and to determine if prints deepen with age.

Since the patterns on the tips of the fingers are each and every one unique, finger printing is the most simple and effective method of identification.

In this project the student researched different types of fingerprints (i.e., arch, loop, and whorl).

To find the percentages of occurrence of each type of print, the student took prints from 164 Sheridan High School students from grades ten through twelve.

In doing research, the student found that the subsidary ridges deepen with age. With that in mind, the student took prints from: children, ages 7-9; teens, ages 15-18; middle-aged adults, ages 39-40; and older adults, ages 65-70.

The pattern on our fingertips remains the same from birth until death if nothing happens to the papillae. Injuries which affect the outer layer of the skin do not alter the ridge structure, but if the papillae are destroyed, the ridges will disappear.

The student took prints of eight students who had cut their papillae. In the places where the print was cut, the finger was bald.

To disprove the belief that the type of print a person has is inherited, the student took prints of each member of a family and of two sets of twins from different families.

THE TOXICOLOGICAL AND ABSORPTION PROPERTIES OF 2,4-D ON THE DROSOPHILA

Frank, Diane E., St.Clair H.S., St.Clair, MN 56080
RTE 4, Box 111, Mankato, MN 56001

This experiment tested the amount of 2,4-Dichlorophenoxyacetic-Acid in experimental Drosophila Melanogaster larva.

To test this condition, four experimental vials were prepared by adding a solution (.469ml of 2,4-D to 100ml water) to the medium. Adult flies were placed in each vial and reproduced. The larva were allowed to develop naturally. Twelve specimens were collected from each instar. Specimens of abnormal brown larva were collected in the late third instar. These were often found dead. The specimens were taken to Mankato State University, where I prepared and analysed them. Gas Chromatography with the electron capture method was used.

The amount of 2,4-D found in the larva was small. The average amounts of the two trials were as follows: first instar- .104ng, second instar- .083ng, third instar- .087ng, late third instar- .146ng.

Although this amount was minute, the mass of the larva is also very small. If the larva broke down the 2,4-D, it would no longer register on the G.C., but may be very toxic. By searching literature, a link between 2,4-D and ensyme or microorganism damage may be made. This is currently being done.

#TRAIL PHEROMONES OF FIRE ANTS: DIFFERENT MOLECULES FOR DIFFERENT TRAILS.

Ellgaard, Annemarie K., Grace King H.S., Metairie, LA 70002
6512 Wilty St., Metairie, LA 70003

Red imported fire ants, Solenopsis invicta, were homogenized and extracted in acetone, chloroform, diethyl ether, ethanol, petroleum ether, or water. To analyze for trail pheromones, the solvent extracts were applied to filter paper to form circular paths on which percent trail following by ants was then determined. Diethyl ether, ethanol, petroleum ether, and water all appeared to extract trail molecules. That trail molecules were observed in solvents with different physical characteristics suggests that the structure of trail molecules is heterogeneous.

Wilson (1962) reported that the trail of this species is made with a highly volatile pheromone which disappears within 20 minutes. Consistent with this, one control solvent, petroleum ether (a mix of highly volatile hydrocarbons), established a short lived, 10 minute trail. In contrast, all solvent extract trails persisted for at least 4 hours, suggesting that there are also a group of less volatile trail pheromones. Observations on natural trails supported this interpretation. Food foraging trails persisted for only 30 minutes, while nest relocation trails remained effective for 12 hours or more.

Less volatile long chain hydrocarbons have recently been extracted from Dufour's glands (Barlin et al. 1976, Attygalle et al. 1983). Therefore trails were made using the hydrocarbons, pentadecane, hexadecenal, heptadecane, and nonadecane. Only pentadecane elicited trail following behavior and the trail persisted for 2 hours.

It thus appears that a highly volatile pheromone is used to mark short lived food foraging trails, while less volatile molecules, including pentadecane, are used to mark nest relocation trails.

#Fourth Award - General Motors ISEF
Honorable Mention - United States Army

#A THREE YEAR INVESTIGATION INTO THE CONTROL OF THE COMMON CAT FLEA, CTENOCEPHOLAIDES FELIS FELIS (BOUCHE')

Blake, Julia J. Suwannee High School, Live Oak, Florida 32060
312 Gay Street, Live Oak, Florida 32060

The purpose of my project is to find the most effective way to kill the common cat flea, ctenocephalides Felis Felis (Bouche'), which is the flea that is most often found in Florida on house pets.

My hypothesis is that some products are better than others in controlling the common cat flea.

The materials I used were commercial flea powders and sprays, insecticides used by qualified pest control operators, talcum powder, tobacco dust, naphthalene, diatamatious earth, glass test tubes, flea hatching apparatus, cotton, and carpet.

Over a period of three years, I did various experiments using flea powders, sprays, and insecticides. I tested them and compared the results. Also in my tests, I developed a formula for home-made flea powders.

I found that generally flea sprays worked better than flea powders and the home-made flea powder worked better than the commercial flea powder. In the test with the insecticides on carpet, any of the three insecticides used in the experiment will effectively control live fleas but Dursban or Ficam Plus would be more effective on both live fleas and cocoons.

#Third Award - Entomological Society of America

#DISCOVERY AND ANALYSIS OF NOVEL MEMORY STYSTEMS IN LOWER INVERTEBRATES

Minyard, William P., Starkville H.S., Starkville, MS 39759
202 Windsor Road, Starkville, MS 39759.

This research is directed towards establishing a model for planarian behavior which can be used for further neurophysiological research. Objectives are: (1) to determine if "savings" (quicker learning during retraining) actually measure two independent memory systems; (2) to determine if these two memories are physiologically different by feeding to untrained planaria RNA and protein extracts from trained planaria in an attempt to transfer each memory system; (3) to study protein composition of planaria using electrophoresis separations and to correlate behavioral differences with specific chemical differences in various groups of planaria; and (4) to make inferences about mechanisms for behavior from memory transfer and protein composition results.

Training involves three seconds of light paired with electric shock in the final second. Planaria contract to shock, but not to light. A conditioned planarian will contract to light in the first two seconds.

This research proves conclusively that savings and direct recall are not simply two different methods for measuring a single memory, but that they are in fact two independent memory systems. Furthermore, this research finds that savings and direct recall are physiologically dissimilar and finds specific biochemical correlates for savings, direct recall, and extinction (elimination of direct recall) memories. Hence, this research has discovered a new model for planarian behavior associated with a simple conditioned response and has provided some specific chemical correlates for these behavioral changes; this new model provides a powerful tool for the eventual understanding of the learning process both psychologically and physiologically.

#First Award - General Motors ISEF

DESCRIPTION OF A NEW ASTOMATE CILIATE (HAPTOPHRIDAE, CEPEDE, (1923): A SYMBIONT OF THE PULMONATE GASTROPOD, CERION STRIATELLUM SOWERBY IN SOUTHWESTERN PUERTO RICO

Vega, Julio, Lola R. de Tio High School, San Germán, P. R. 00753;
Bo. Cotto, Carr. 347, Km. 1.7, SanGermán, P. R. 00753.

Cerion striatellum Sowerby, 1875 is a pulmonate gastropod found in the xerophytic coast of southwestern Puerto Rico. It lives adhered to rocks, tree trunks, cactus and among grass in the dry season. C. striatellum is limited to the southwestern region of the island. This gastropod harbors a symbiotic protozoan. This a highly curious ciliate, not found in the literature, thus representing a new species.

The study involves 4 stations, 3 of which are positive for the ciliate. One hundred snails were examined per station to determine incidence of infection which turned out to be very high with percentages of 91% with 58 ciliates/snail for Caña Gorda, 85% with 53 ciliates/snail for Bahía Sucia and 71% with 46 ciliates/snail for Tamarindo.

The new ciliate belongs to the Order; Astomata and the Family: Haptophridae. It has been named Proclausicola portoricensis n.sp. It is 479.01 u in length and 68.53 u in width. It shows 27 contractile vacuoles, a macronucleus, no micronucleus and the body is covered by 53 ciliary meridians dorsally. The anterior part shows a bal band. The cytpolasm is full of granules. Differential staining has shown the presence of lipids and polysaccharides. Reproduction is by binary fission and shows a rare type of pairing without interchange of nuclear material.

There is a clear symbiotic relationship between the gastropod and the ciliate. It seems to be a commensal since it does not seem to harm the host yet all known members of the order are parasitic.

#Third Award - General Motors ISEF

FETAL DEVELOPMENT OF THE WHITE-TAILED DEER

Elliott, Sandra D., Berkeley H.S., Moncks Corner, SC 29461;
Rt. 5 Box 677, Moncks Corner, SC 29461

The purpose of this experiment was to establish criteria in terms of body size and the development of external characters of white-tailed deer fetuses, which can be used to differentiate the unpredetermined age of fetuses. Additional purposes of this experiment were to compare the results of this experiment to those of a similar experiment done by Ruth Allison Armstrong in 1950; to make various sex comparisons between singletons and twins; and to relate fetal age with the progression of ossification in the fetal skeleton.

The first priority concerning the format of the experiment was to take a series of linear measurements and to record the results. Since all of the available fetuses were of predetermined (by the South Carolina Wildlife Marine Resources Department) age, it was possible to then go to the youngest fetus and sequentially examine each specimen. All fetuses were examined with the aid of a microscope and a hand lens. As a character was percepted, it was recorded in accordance with its age. This format was used on all fetuses ranging in age from five to twenty-eight weeks of age.

As far as studying the progression of ossification, x-rays were taken of the fetuses ranging in age from five to twenty-eight weeks of age. The x-rays were sequentially examined according to age and all findings were recorded.

Due to extreme length, all developmental criteria and conclusions are housed within the research papers.

#First Award - Eastman Kodak Company
Third Award - General Motors ISEF

#RADIATION AND REGENERATION: TESTS ON PLANARIA

Pickle, Steven J., William J. Palmer H.S., Colo. Springs, CO 80903
20 West Caramillo, Colorado Springs, CO 80907

My purpose was to study the effects of radiation upon organisms with rapidly growing cells, such as regenerating planaria. I radiated 4 groups of 50 bisected planaria with X-rays at doses of 10, 50, 100, and 500 rads and 4 groups with electron radiation at the same dosages. One unradiated group served as control. I made daily observations for 20 days.

All groups except those exposed to 500 rads regenerated normally (i.e., had undergone phagocytosis and proceeded to build new tissue) until day 4 when regenerative growth stopped. Those in the 500 rad groups never went through phagocytosis or showed any signs of regeneration. On day 7 planaria began to die and by day 20 all in the 500 rad groups were dead, while other radiated groups had unusually high death rates, with those radiated with X-rays having higher death rates than those radiated with electrons. The control group, meanwhile, proceeded normally; by day 10 all the planaria were fully regenerated and by day 20 none were dead.

The data collected suggested the following conclusions:

1. X-rays do more damage to planaria than electrons.
2. Radiation at high doses can stop most regenerative functions in planaria, including phagocytosis.
3. Radiation at lower levels can stop mitosis.

The project clearly showed the damaging effect of radiation on the two vital cell functions of planarian regeneration, phagocytosis and mitosis.

#Fourth Award - General Motors ISEF

FACTORS INFLUENCING PLANARIA REGENERATION

Parvin, Greg A., Alcorn Central High School, Glen, MS 38846
P. O. Box 135, Corinth, MS 38834

This experimentation dealt with the regenerative abilities of planaria, Dugesia dorotocephala. Different factors were tested in trying to reduce the time span required for the complete regeneration of planaria.

The planaria is in the Platyhelmenthes Phylum and in the Class Turbellaria. Due to the presence of the mesenchyme cell, the planaria has the ability to regenerate.

This experimentation consisted of two phases. In the first phase, the planaria were bisected in a vertical plane. In the second phase, the planaria were trisected in a vertical plane. These two phases were used in each of my seven experiments: vitamins, minerals, pH levels of water, X-Ray radiation, color of light, intensity levels of light, and temperature levels of water.

The results of this experimentation are as follows: vitamins are much more effective than minerals in decreasing the time span required for the regeneration of planaria. Acidic water is helpful in the diminution of the time span required for regeneration in planaria. Planaria cannot regenerate after being exposed to X-Rays. Planaria can regenerate fastest under gray light. Planaria regenerate fastest when exposed to a small amount of light. Planaria regenerate fastest in cooler temperatures.

After the information was gathered, the experimentation completed, and the results interpreted, it was concluded that the time span required for complete regeneration of planaria can definitely be decreased and increased by external and internal factors.

#A NEW ANSWER TO SURGICAL SEXING IN AVIAN SPECIES

Jarman, Todd E., Roy High School, Roy, Utah 84067
4821 So. 3200 W., Roy, Utah 84067

Identification of sex in many avian species is considered impossible, unless a procedure of surgical sexing is used. However, through the author's research, a new sexing procedure has been developed using a microscopic technique of examination of barbs, barbules and barbicels. It has been proven that many avian species normally requiring surgical sexing can be microscopically sexed. Although studies were performed on galliformes and anseriformes, the primary subject were psittaciformes and columbiformes. It was found that many could be microscopically sexed, but others need more research to determine slight differences in male and female feather characteristics. The sexing procedure is presently beginning to be used by breeders and in some pet shops.

#First Award - United States Army
Third Award - General Motors ISEF

OSMOREGULATION IN THE CRAYFISH ORCONECTES IMMUNIS

Tomashek, John J., Fred N. Thomas Career Education Center
2650 Eliot Street, Denver, CO 80211
3421 South Utica Street, Denver, CO 80236

The purpose was to determine the relationship of the glucose to the Cl- levels in the haemolymph of the freshwater crayfish Orconectes Immunis when it is subjected to a hypertonic environment. Crayfish were collected at Washington Park, Denver and placed in holding tanks at the Career Education Center. Solutions of 1% and 2% NaCl were prepared. Each crayfish was placed in 200 ml of its respective solution. Tests were conducted at 0, 1, 3, 6 and 10 hours. The glucose level of the blood increased sharply in the first one to three hours and then decreased slowly. The Cl- level remained constant. The rise in glucose is most likely attributable to the need to provide energy for active transport, in particular sodium-potassium pumps, and to act as an osmotic effector.

THE REESTABLISHMENT OF RETICULITERMES FLAVIPES' AND COPTOTERMES FORMOSANUS' COLONIES WITHOUT THE USE OF A KING AND A QUEEN

Campbell, Olivia Suzanne, Biloxi H. S., Biloxi, MS 39531: Father Ryan Ave., Biloxi, MS 39531.

Luscher (1961) has stated that termites are able to molt from one caste member to another. Are they able to do this and reestablish their colony? Workers of Coptotermes formosanus and Reticulitermes flavipes were isolated into groups of 300. They were given a food supply and time was allowed to elapse for a maximum of ten weeks. The workers molted and started replacing the members in their caste. They first replaced them with soldiers, presoldiers, nymphs, then they started replacing the reproductives. All of the evidence proved that workers were able to reestablish their colony. This experiment that I performed proved that even if parts of a caste are missing that it will not destroy the colony because eventually they will find someway to replace the lost parts.

#NOTES ON THE BEHAVIOR OF THE SHRIMPS TULARIOLARIS NEGLECTA CHACE, 1969 AND PERICLIMENES SP.: SYMBIONTS OF THE ECHINOID DIADEMA ANTILLARUM PHILIPPI IN PUERTO RICAN WATERS

García, José A., Blanca Malaret High School, Sabana Grande, P.R.00747; Urb. Villa Alba C-36, Sabana Grande, P. R. 00747.

This study attempts to describe the symbiotic association between the echinoid Diadema antillarum Philippi and the shrimps Tulariocaris neglecta Chace, 1969 and Periclimenes sp. in the shallow waters of Puerto Rico and to ellucidate the mechanisms underlining this relationship. The morphology of these shrimps was studied as well as their behavior under natural and laboratory conditions. A total 8,753 echinoids were collected with 4,865 shrimps. The sexual difference, reproduction and differences in the rostrum of T. neglecta were observed.

Host specificity trials were conducted to test the preference of the shrimps toward their natural host, five other echinoids, nine color facsimiles, a coral and a rock. T. neglecta prefered D. antillarum over all other urchins with 100% of preference in an average time of 0.16 secs. This was followed closely by E. lucunter with 99% in 0.34 secs., E. viridis with 99% in 0.38 secs. and E. tribuloides with 98 in 0.56 secs. Peridimenes sp. prefered D. antillarum over all others 93% in 1:25 secs. Results showed the shrimps prefered the dark over the clear echinoids. Tests conducted to find out if the shrimps locate their hosts in the natural environment using visual cues indicate that the shrimp appears to be attracted to the echinoid by usual recognition and that distance is an important factor. It has been observed that defense seems to be an important behavioral trait. Tests conducted to determine if olfaction plays an important part in the location of the host by the shrimp showed that apparently it does not. Tests carried out showed that the direct contact with the spines of Diadema involves the utilization of host epidermis as a food source.

Observations on the behavior of the shrimps were carried out as well as a test on spine preference.

#First Award - Eastman Kodak Company
Third Award - General Motors ISEF

AQUATIC BEETLES (DYTISCIDAE & HALIPLIDAE) IN A COASTAL AREA IN CENTRAL SWEDEN

Jonsell, Mats E., Lundellska läroverket, Nedre Slottsg. 8, 75220 Uppsala, Sweden
Konsumvägen 20 B, 75245 Uppsala, Sweden

In a coastal area in N. Uppland in central Sweden I have compared the composition of aquatic beetles (fam. Dytiscidae, Haliplidae) in various kinds of waters: running waters, fens, waterfilled pits, tarns, small lakes, rock pools and sea shores. The sea (the Bothnian Gulf) is here brackish (salinity 4-5 ‰).

The beetles were caught by means of a pole net and, in fens, by trampling down the vegetation to below the water level and catching appearing beetles by an aquarium net.

The area is highly calcareous and very flat. Postglacial land uplift is considerable (60-70 cm per 100 years), which means that the bays will be successively isolated from the rest of the sea and pass a development towards small lakes or fens. This development implies great changes for the beetle fauna. In the bays I found 13 species (some are probably only casual), but a few species were only found in the brackish water. In recently isolated bays and in small lakes below the 3 m level hardly any species are to be found. Small tarns (area c. 500 m^2) at the 5-10 m level are the localities richest in species. Such places were isolated from the sea 800-1600 years ago.

Totally I found in the area 58 species of Dytiscidae & Haliplidae, which are all enumerated in Table 1. From the province of Uppland 110 species have been reported.

#FIRST COMPLETE DESCRIPTION OF THE LIFE CYCLE OF THE SAWFLY SERICOCERA KRUGII (CRESSON, 1880) (HYMENOPTERA: ARGIDAE): A PEST OF THE SEAGRAPE COCCOLOBIS UVIFERA; WITH SOME ASPECTS OF ITS ECOLOGY AND BEHAVIOR

Pérez, Francisco J., Colegio San José, San Germán, P.R. 00753
Urb. Porta Coeli A-11, San Germán, P.R. 00753

The purpose of this investigation is to completely describe the life cycle of the sawfly Sericocera krugii (Cresson, 1880). A complete review of the literature showed that the life cycle of this species has not been fully described. This organism depends for its life cycle almost exclusively on a very important element of our beach ecosystem, the seagrape, Coccolobis uvifera, to which it causes serious damage.

A taxonomical study of this sawfly revealed that it pertains to the Argidae family, not to the Tenthredinidae family as literature mentions.

The whole coast of Puerto Rico was examined for the presence of C. uvifera. Positive stations were established wherever the presence of the sawfly was detected. Environmental parameters were measured at each station. Percentage of browsing was determined for each station. Eggs, larvae, pupae and adults were collected at stations.

Measurements for the eggs, average number of eggs pre clutch and of clutches per leaf were determined. Three oviposition patterns with no configuration but with different distances between the eggs were found. Changes in color, size and percentage of hatching were also determined. The development of the eggs takes about 17.5 days. It was found that the chorion has a prolongation inside the leaf. Attempts have been made to study the embryological development of this sawfly. Larvae were observed in the field and in the laboratory, and six larval instars were found. The larval period takes about 26.09 days. Time pupal period takes (20 days) and changes inside pupae were determined. Percentage of mortality and the average measurements for the female and male pupae were determined. It was found that the sex of an adult in a pupae can be predicted according to the size. No pheromonal activity has been found and two natural enemies for the sawfly has been found: the larvae of Selenothrips rubrocinctus and Crysopha. The results have been statistically anlyzed.

#First Award - General Motors ISEF
Second Award - Entomological Association of America

FALL-WINTER DIET PREFERENCES OF THE BOBWHITE QUAIL

Dabbert, Charles B., Ardmore High School, Ardmore, Okla. 73401
504 Cottonwood, Ardmore, Oklahoma 73401

The purpose of this research is to improve Bobwhite Quail, (Colinus virginianus), habitat. The two main aspects of quail habitat are food and cover. In this research the aspect of food was considered.

To attract quail you must have the foods they prefer, and have them within a certain distance of the place from which they nest. From this fact three questions arose. They were: what is the maximum and minimum distance quail will travel to feed ; what are the diet preferences of the quail who live in my area, and can I find any foods that quail eat that have not been previously reported?

The research was conducted on two different farms, both of which are owned by the Noble Foundation of Ardmore, Oklahoma. One farm is located west of Ardmore and the other farm is located south of Allen, Oklahoma. A food-habits study and a vegetation inventory were done to have the information required to answer the above questions.

Nature did not cooperate and the question of the distance quail travel to feed is really unanswered. It was found that quail were within 52 feet of an excellent food source and did not eat. This is because of ground litter. It blocked the food from the quail and they couldn't find it.

In my attempt to find new quail foods I was successful. I found that Coffee Senna and Sicklepod are two foods that quail eat in Oklahoma that had not been reported before.

The preferences of quail living on the two farms were Small Wild Bean, Ash species, Vetch species, Paspalum species, Clover species, and Annual Lespedeza species.

#OFFSPRING SEX RATIO IN RATTUS NORVEGEIUS
DETERMINED BY PRE-CONCEPTION DIET

Staley, Kathryn L., Northwest Rankin, Brandon, MS 39042.

127 Westlake Dr., Brandon, MS 39042.

For many years and many reasons people have tried to determine or pre-select the sex of their offspring by some method or another. The purpose of this research experiment is to determine whether nutrition plays a role in determining the sex of offspring in rats.

Experimental I rats were administered a pre-conception diet high in the minerals calcium and magnesium to produce female offspring. Experimental II rats were administered a diet high in the minerals sodium and potassium to produce male offspring.

My hypothesis is that the calcium-magnesium and sodium-potassium change the pH balance in the womb to favor the X or Y chromosome containing sperm. This is due to the fact that the X chromosome operates best in an acidic environment and the Y chromosome adapts better in an alkaline environment.

To test this, Experimental I was adminstered their special diet consisting of 400 mg. per day of calcium and magnesium for 5 days before breeding. Experimental II, the same, but with 400 mg. per day of sodium and potassium, while maintaining the Control Group on a regular lab diet before and after breeding.

During their gestation period they were closely observed for any abnormal effects. The pH balance was tested for the mineral content in the blood. Their blood pressure was also tested four times.

At the end of gestation, the sex of the offspring was determined and the statistics were analyzed. This research showed that the Control group offspring male to female ratio was 94 to 89. In the Experimental I offspring male to female ratio was 68 to 26. In the Experimental II offspring male to female ratio was 22 to 65.

#First Award - United States Air Force

BIOLOGICAL ASPECTS OF ASPIDUCHUS CAVERNICOLA (REHN, 1951) AND PERIPLANETA AMERICANA (L.) (ORTHOPTERA: BLATTIDAE): SYMPATRIC POPULATIONS IN A CAVE IN SOUTHWESTERN PUERTO RICO

Rivera, Leoncio, Lola R. de Tio H.S., San Germán, P. R. 00753;
Calle A Buzón 222, San Germán, P. R. 00753.

This investigation is an attempt to increase our knowledge of the cockroach Aspiduchus cavernicola (Rhen, 1951), an endemic cave dweller from southwestern Puerto Rico. Practically nothing is known of the biology of this very interesting genus. This species is found in Cueva de Monte Grande in Cabo Rojo, Puerto Rico living sympatricaly with the cosmopolitan species in Periplaneta americana (L.). Through a comparison of both species, their populations and their interactions it is hoped to improve our knowledge on this species.

The study involves a description of the cave, the environmental parameters taken for a 24 hour period, the taxonomy and the population density. A study of competition revealed Periplaneta has a larger population and outlasts Aspiduchus. Food items, cannibalism, predators and diseases were factors studied. The external and internal anatomy of both species was studied. Measurements of length and width of body, three legs, antennae and wings were taken and standard deviations determined, for each measurements, for males and females. The phallus, ootheca and digestive tube were studied. The phallus of Aspiduchus indicates it is a more primitive organism than Periplaneta. Aspiduchus turned out to be ovoviviparous. A. cavernicola is bigger than Periplaneta.

Chemical analysis was carried out to determine water, organic matter and mineral content. Protein concentration and amino acids were compared. Oxygen consumption, ovyposition, righting response, ranges of antennae movement, velocity, surfaces they climb and gromming behavior were also compared.

ESTRUS SYNCHRONIZATION COMPARISONS

Andersen, Karen L., Scranton High School, Scranton, ND 58653
RR 2 Box 15, Scranton, ND 58653

The purpose of my project, "Estrus Synchronization Comparisons", is to compare artificial progesterone test results done by the drug companies to those done at my family's ranch. I also compared my results with those of various ranchers who had also used these products.

When I initially began my project, I wrote to the different drug companies, AI services, and livestock magazines. The information I received I used as a reference throughout my project.

For my testing I used the following method: 1. Inject 5ml Lutalyse intramuscularly (25 mg dinoprost); 2. Repeat the injection 11 days after the first injection; 3. Observe for estrus after the second injection; 4. Inseminate at the usual time relative to detection of each estrus following the second injection; 5. If the cattle are estrous cycling, estrus is expected to occur 2 to 5 days after the second injection. Cattle that do not become pregnant to that breeding will be expected to return to estrus between days 21 and 27 after the second injection.

Of the 38 cows treated, 33 came into estrus 2 to 5 days after the second injection, the remaining 5 cycled at days 8, 11, 16, 17, and 19 respectively after the second injection. I had an 87% catch, where the drug companies tests show only a 55% catch. This large variance could be caused by factors such as age, weight, or condition of the cattle used. The cattle I used were flushed with a high phosphorus feed and were gaining weight.

#TEMPERATURE VS. GENE CONTROLLED DEVELOPMENT IN DROSOPHILA

Simmes, Tina N., North Toole County High School, Sunburst, MT 59482
Box 39, Sunburst, MT 59482

This experiment was undertaken to determine if different temperatures have an effect on wing length development in drosophila. Wild type and vestigial winged fruit flies were placed in separate culture tubes and put in an incubator set at a constant temperature of 25 C. The parents were removed after eggs were laid and the flies were allowed to develop their entire life cycle at this temperature. When the flies were removed from the incubator, the wing lengths were measured. The experiment was repeated only this time the flies were put in an incubator at a higher constant temperature of 30 C. Another experiment was also carried out to determine what specific stages of development (larva, pupa) were most suspectible to environmental temperature influence.

Higher temperature does effect gene control for wing development in vestigial winged fruit flies. However it only affects vestigial flies, indicating this gene is less stable than the normal one in the wild type flies (could this be true for all mutant genes?). Also, the higher temperature influences the gene in the larva stage of development but not in the pupa stage. The higher temperature does not exert a different influence in the different sexes.

#Fourth Award - General Motors ISEF

THE EFFECT OF PHEROMONES ON ANT BEHAVIOR

Newsom, Brent A., Pensacola Christian H.S., Pensacola, Florida 32523
225 Man-O-War Circle, Cantonment, Florida 32533

PURPOSE: Establish that ants communicate by pheromones and how; identify responses to natural and certain artificial pheromones. EXPERIMENTS & RESULTS: Solenopsis invicta colony was deposited in arena with artificial nest. Ants migrated into side entrances. After nest was rotated 90 degrees, ants followed known trail to the old hole positions but did not enter. A trail was made with crushed abdomens. Ants followed this trail but did not respond to the control (crushed heads). Trails were made on paper within the arena of ethanol, antifreeze, ink and brake fluid. Trail following responses were: ethanol-4 ants, 3.56" average; antifreeze-5 ants, 2.4" average; ink-5 ants, 2" average; brake fluid--none. 10 cc of air was taken from bottle with 100 alarmed ants and injected into bottle with 10 "contented" ants. Four ants were alarmed but none responded to the controls (plain air; w/o antennae). Twenty heads were crushed and put in bottle with 10 ants. Four ants were alarmed but none responded to the controls (crushed abdomens; w/o antennae). Colony response to 30 cc fume injections: of turpentine--was 90% dispersion 6" radius; of paint stripper--none; of citrus oil--30%, 4". None responded to the control (plain air). Citrus oil was used as an alarm pheromone to interrupt a known trail. None responded to the control (citrus oil). CONCLUSIONS: Ants mark trails and signal alarm with pheromones from glands in the abdomen (trail) and in the head (alarm). 70% ethanol and certain glycols are effective as trail pheromones; certain terpenes mimic alarm pheromones. Alarm pheromone can be used to interrupt a known trail. APPLICATION: Insecticides can be harmful to the environment and carcinogenic. Pheromones show promise as a safer means of insect pest control.

#Fourth Award - General Motors ISEF
Honorable Mention - American Psychological Association

THE EFFECT OF CYCLOPHOSPHAMIDE ON THE BEHAVIOR AND REPRODUCTION OF MUS MUSCULUS

Brandenberger, Debra Lee, Mason H.S., Mason, TX 76856
Menard Rt. Box 20, Mason, TX 76856

In the first year three mice were given different dosages of cyclophosphamide (cytoxan). There were weighed each day for twenty-five days. and this weight was recorded on charts and graphs. The code green mouse received .3cc, the code blue mouse received .12cc, and the code white couse received .24cc of cytoxan. After each mouse received her shot she was observed for an average of ten minutes. During this time frame her reactions were compared to a normal mouse and recorded on tables. After twenty-five days of this procedure the mouse which received .12cc was dissected and compared to a normal mouse. The deffects which were found may have been from the regular use of cytoxan.

In the second year, first part, eight mice were chosen. The ones coded C-1 through C-4 received .3cc and the mice coded NM-1, NM-2, RED-1 and RED-2 received .12cc of cytoxan. The C-1 through C-4 showed definite signs of conceivment. This procedure was continued for thirty days. Following the sixty days the female was observed, without a male mouse, for thirty days. In the total of ninety days none of the female mice showed signs of conceivment.

In the second year, part two, nine female mice were given different dosages of cytoxan in an effort to study their offsprings. The mice again received either .3cc, .12cc,or .24cc of cytoxan. Following this procedure for thirty-one days a male mouse was placed with the female mice for sixty days. For thirty days following the removal of the male mouse the female mice were watched closely for any signs of conceivment. At no time during the ninety days did the female mice show any signs of conceivment.

THE EFFECT OF OXYTOCIN ON THE REGENERATION OF PLANARIA

Dean, Kent D., Barry H.S., Barry, IL 62312
R.R. 2 Box 80-A, Barry, IL 62312.

The purpose of my project is to evaluate the effect of oxytocin on the regeneration of planaria. Oxytocin and cystine were selected for the study because: 1.) Oxytocin is a hormone that causes constriction of smooth muscle and planaria have smooth muscle; 2.) Oxytocin and cystine contain disulfide bonds, similar to other chemical substances known to inhibit protein synthesis; 3.) Cystine is one of the amino acids in oxytocin.

Planaria were cut in half; the heads were placed in artificial medium with three different concentrations of oxytocin and cystine ($8x10^{-14}$M./L., $8x10^{-16}$M./L., $8x10^{-18}$M./L.) and observed every 12 hours to evaluate the degree of regeneration.

The higher concentration of oxytocin appeared to constrict smooth muscle. The higher concentration of oxytocin and cystine slowed regeneration. Therefore, these two compounds with disulfide bonds appear to inhibit regeneration of planaria.

AN INDEPTH STUDY INTO THE FEEDING PROCESS OF COLUBRIDAE

Couvion, Eric, Christoval H.S., Christoval, TX 76935
Post Office Box 114, Christoval, TX 76935

To better understand and to find a way to use Colubridae to our advantage I began my research.

I first tested the use of stimuli to observe the sense organs ability to distinguish between living and nonliving organisms. I tested the Colubridae's ability to differentiate between live and nonliving mice as prey. I used balloons filled with warm and cold water, (to represent the flow of blood), and warm and cold air. The balloons were various colors (blue, red, yellow). Tests show that the sense organs can determine and detect the flow of blood and heat as well. After striking, I observed the Colubridae attaching its teeth to the neck of the victim. Then he wraps his body around and squeezes until its prey is dead. This process is known as constricting. The Colubridae then places the head of the victim in its mouth and proceeds to swallow it. The jaw bones detach from one another to allow the Colubridae to swallow an animal larger than itself. The muscles then push the prey to the digestion area.

Dissection was used to observe the internal system and to test the Ph of the chemicals used to dissolve the food which is swallowed. The digestion organs are long and slender. The liver is found after the trachea followed by the stomach, intestines, and gall bladder. The Colubridae dissected was a garter snake (killed by the cooling down of the body and then neck dislocation). It was fed 8 hours before dissection. When chemicals were extracted from the digestion area, food particles were still there. The Ph was strongest in the liver and weakest in the stomach. The intestinal acid was about the strength of the stomach.

DETERMINATION OF THE MINIMUM NUMBER OF INVERTEBRATES REQUIRED TO SUPPORT A DAMSELFISH: PART I DETERMINATION OF NITROGEN

Woodson, Charles H., Osbourn H.S., Manassas, VA 22110
9312 Stuart Ave., Manassas, VA 22110

This project is intended to determine the minimum number of invertebrates required to support a damselfish. This will be carried out in two parts. The first part (this project), will find the amount of nitrogen produced by the fish. Weekly water testings will reveal the changes in the aquarium's content of nitrite, nitrate, and ammonia during a twenty four hour period of nonfiltration. Filtration will then resume for six days, in order to reduce stress on the fish. The amount of nitrogen produced by the fish will be needed for the determination of the effectiveness of the second part of the experiment. The second part (next year's project) will determine the number of invertebrates required to consume this amount of nitrogen. This will be done by putting the fish into an already established invertebrate system, with only a biological filter (corals, plants, and other invertebrates), and recording the amounts of ammonia, nitrite, and nitrate produced by the system; once there is no increase in these levels, invertebrates will be removed until there is no increase in these levels, invertebrates will be removed until these levels begin to increase again. This will be less than the minimum, therefore the number of inverbetrates before the last removal should be the minimum number required to support a damselfish. If this experiment successfully determines the number of invertebrates required to support a damselfish, it might prove useful to not only small hobby aquariums, but also to larger commercial and public aquaria.

IS THE ACTIVITY OF COMMON BACKYARD RODENTS (MICE) AFFECTED BY THE WEATHER?

Horton, Caroline K., Grand Blanc High School, Grand Blanc, MI 48439
418 Hattie, Grand Blanc, MI 48439

My project concerns the study of rodents' (mice) feeding activity in relation to daily weather conditions. To carry out my experiment, I placed eight feeding stations in various places in my backyard. These stations electronically measured the number of feeding trips the rodents made each day. I achieved this through placing diodes on either side of the opening in each of the eight feeding stations. Every time a rodent entered or left the station, an infrared beam, created by the diodes would be broken, causing an electric current to activate a graph recorder located inside my house. At the end of each twenty-four hour period, I counted the number of marks on the recorder's graph paper and compared it to various weather conditions each day. At the end of my research, I concluded that the feeding activity of rodents (mice) is determined by the weather. They feed more when the barometer is falling, or at a low level and less when the barometer is rising, or at a high level.

This finding shows that the feeding activity of rodents (mice) is indeed affected by the weather, specifically the barometric pressure. In addition, I also found, contrary to literature and many experts, mice are not nocturnal. I found they feed all day long, with no specific feeding pattern in relation to the time of day.

THE EFFECTS OF HIDDEN SODIUM ON THE HEARTBEAT OF DAPHNIA

Kudrak, Mary E., Northwestern H.S., Kokomo, IN 46901
1210 Devon Court, Kokomo, IN 46901

The purpose of this experiment was to determine the effects of hidden dietary sodium on the heartbeat of Daphnia, a transparent crustacean. Seven products containing hidden sodium were used in three concentrations. A control of aquarium water was also used. Five Daphnia in each solution were tested after fifteen minutes, one hour, and four and a half hours. For each test group, the following observations were made: heartbeats per minute, hot-cold stress reaction in beats per minute, movement of appendages per minute, stimulus-response, overall speed of movement, pH of the water, and temperature of the water.

A chi-square test was used to analyze the heartbeat and appendage movement data. By comparing the data of the sodium solution observations with that of the control observations, one can show that the Daphnia were unquestionably affected at the 1% level of significance.

Based on recorded observations and chi-square data, the substances containing hidden dietary sodium significantly increased heart rate and appendage movement of Daphnia. An increase in exposure time added to the stress which was caused by the hidden sodium. Overall speed of movement increased as the sodium ion concentration in water increased. Stimulus-response data remained constant. Water temperature and pH of the water had no effect on the results.

UTILIZATION OF ALFALFA BY RABBITS

Hunkley, Richard, Black River High School, Sullivan, Ohio 44880
46837 West Bursley Road, Wellington, Ohio 44090

Objective: To create an alfalfa/grain diet that would result in better fur coat, better conception ratio, more nutritious lactation, and more control of enteritis.

Procedure: I studied various feed ratios and did alfalfa diet experiments on my rabbit herd. The alfalfa to grain ratios I used were as follows: 100%/0%, 70%/30%, 60%/40%. I then reversed the experiments with the following grain to alfalfa ratios: 100%/0%, 70%/30%, 60%/40%.

Results: I obtained a feed/grain diet that has worked but needs some improvements due to the saponin in the alfalfa reducing the alfalfa intake. I am presently working on a project to genetically produce bunnies that will take in 45% or more of high saponin alfalfa.

Conclusion: Because of the saponin in the alfalfa I have had some problems with enteritis in the bunnies. In regards to the fur coats, the alfalfa diets fed kept an edge over the grain diets in all of my experiments which were done over periods of three weeks, four weeks, six weeks, eight weeks, and four months. Lactation experiments showed that alfalfa diets produced heavier bunnies, weighing between 13 3/4 oz. and 15 1/2 oz. at eight weeks of age. The grain diets produced bunnies weighing 11 oz. to 12 oz. at eight weeks of age. Breeding experiments showed no comparable difference in offspring, aged four to eight weeks, from does fed alfalfa diets and does fed grain diets. When offspring were about four months old, those from alfalfa does had a better fur coat than those of the grain fed does.

#First Award - American Veterinary Medical Association
Second Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent Office Society

CRAYFISH CAMOUFLAGE: A STUDY OF CHROMATOPHORE FUNCTION IN PROCAMBARUS

Roop, Timothy J., West Florence H.S., Florence, SC 29501
1520-A Bellevue Dr., Florence, SC 29501

Color changing in the crayfish Procambarus clarkii was investigated. Animals were placed in different aquaria: green, blue, red, orange, white and black; and compared with crayfish kept in a clear tank. The animals kept in the black and orange aquaria showed strong coloration (darker and lighter, respectively); the animals in the green and blue aquaria showed weak changes (somewhat darker), whereas the animals in the red and white aquaria showed no noticeable changes from the control group. This proves that crayfish change color to match their background by using pigmented cells called chromatophores.

Sightless animals kept in a clear aquarium turned as dark as normal animals kept in total darkness, thus proving that sight is essential in chromatophore operation.

Eyestalk extracts from dark-adapted animals were injected into a light-adapted crayfish, causing it to darken, even though it was kept in a clear tank. Eyestalk extracts from light-adapted animals were injected into a dark-adapted individual, causing it to lighten, even though it was kept in a lightless tank. This proves that the eyestalks contain hormones, carried by the bloodstream, which control chromatophore function.

This series of experiments demonstrates that crayfish change color by using chromatophores controlled by eyestalk hormones that are released into the bloodstream in response to different environmental lighting conditions.

WHAT ARE THE EFFECTS OF THE EXTERNAL MAGNETIC FIELD ON THE REGENERATION OF PLANARIA?

Crawford, Pam, Antioch High School, Antioch, California 94509
1809 Blossom Drive, Antioch, California 94509

The regenerative process of the control and experimental planaria was observed. The planaria were divided into three groups, each group containing ten planaria. (There were three control groups and three experimental groups.) Each group was given a different type of incision; an anterior-transverse, a mid-transverse and a posterior-transverse incisions. These incisions subdivided the planaria into two subsequent pieces, each part placed in a container with its respective counterparts. The experimental groups were then exposed to a magnetic field generated by an electromagnet, while the control groups remained under normal conditions. For seven days (each trial), the regenerative process of the planaria was observed, looking for the visible formation of the eyes, tails, auricles and the new regenerated tissue.

Significantly positive results were obtained. The experimental groups regenerated one to two days ahead of the control groups. Thus far, the results seem to indicate that magnetism enhances the regenerative process in planaria. There is a possibility that magnetism can be used further to regenerate damaged heart muscles and nerve cells in humans. Another possibility for the future is the use of magnetism to raise the membrane potential of cancerous cells, thus halting their spread. Many medical uses for magnetism as a catalyst in the healing process in humans are being tested. Thus far, research has been conducted using magnetism, via electrodes, to heal broken bones. By directly implanting the electrodes into the bones, the healing process is significantly enhanced. Based on these facts, I decided to see if these same magnetic principles apply to lower organisms.

#THE GALL INSECTS OF CHRYSOTHAMNUS SP.
IN THE ST. GEORGE, UTAH AREA

Heppler, Heather Lynn, Dixie H. S., St. George, Utah 84770
63 West 650 South, St. George, Utah 84770

Plant galls from CHRYSOTHAMNUS (rabbit brush) were removed with part of the stem,taken back to the lab. and incubated in a warm-moist environment. As the insects hatched they were identified. Some of the TEPHRITIDAE were placed in vials with blue DROSOPHILA medium. Some of the galls were opened and the larvae and pupae were placed in similar vials to see if they would complete their life cycles in an artificial environment. Some of the parasitic wasps were also placed in the medium to see if they would live and mate.

I was successful in getting the fruit flies to complete pupation in the medium. I have several cultures of the flies but so far have not been able to get them to reproduce.

One interesting genetic problem has been found. Almost all of the fruit flies have had green eyes. There are about 70% female and 30% male but some flies have red eyes and so far all of them have been female. This might be some type of sex related characteristic.

In the future I plan to attempt to isolate the chemical that causes the galls to form and also determine which of the many insects using the galls are actually causing the growth of the galls. I would also like to determine if the female injects some type of chemical when she oviposits the eggs or if the larvae are causing the galls to form. I also plan to do some work with the genetics of the flies and see if the gene that is causing the red eyes in a sex related one. This work will depend on being able to get the cultures to live and reproduce in the artificial medium. They have remained healthy for over a month but I have observed no sign of reproduction.

#Honorable Mention - Eastman Kodak Company

A STUDY OF THE SCHOOLING INSTINCT OF THE WESTERN MOSQUITOFISH

Lowe, James R., Clearfield High School, Clearfield, Utah 84015
860 East 400 North,Kaysville, Utah 84037

For the purposes of the observations I made, about 300 Western Mosquitofish (gambusia affinis affinis) were collected from fresh water streams near the Great Salt Lake. These fish are plentiful, though they were originally introduced by mosquito abatement offices to eat mosquito larvae. The predator used was the bluegill (lepomis macrochus Rafinesque). I purchased two children's wading pools and used a small pump to create a current. The pool bottoms were painted white.

When two fish are alone in the pool with the predator, they stay within twelve inches of each other at all times, usually much closer. The larger prey fish is accepted as the leader, and both fish swim in the same direction and parallel (polarity). When a third prey fish is introduced, the follow-the-leader pattern is broken, though the fish maintain polarity and keep their positions in the school. This is also true of larger schools. There is no accepted individual leader at any time.

The school shows no definite lattice structure, but it always shows polarity. If a predator attacks the school from the side, the fish burst away from the predator in all directions (flash expansion), and re-form away from the bluegill. If the predator attacks from behind, the school separates to each side, circles the larger fish and re-forms behind the predator (fountain effect). The small fish seem more able to avoid the bluegill in a school because the predator isn't as able to select a single fish to go after when the school moves

Repeated observations and experiments produced the same results many times, with little variation in the schooling patterns.

#EFFECT OF GROWTH HORMONES ON THYMIDINE UPTAKE IN FIBROBLASTS.

Williams, Michael D., Terre Haute South Vigo High School, Terre Haute, IN 47802; R. R. 25, Box 67, Terre Haute, IN 47802

Growth hormone (GH) has long been recognized as the major growth-promoting hormone in mammals, including man and food-producing animals. Despite the wide variety of responses using in vivo techniques such as growth measurements or enhanced wound healing, there are few in vitro systems in which to study the mechanisms of action of GH. The purpose of this study was to develop a rapid in vitro system sensitive to physiological concentrations of GH derived from cattle, humans, and genetic engineering sources. Through the use of radio-ligand techniques, it was established that a rabbit fibroblast cell line (RAB-9) contained high affinity receptors for GH and rat prolactin (PRL). The GH receptor may be coupled to cell proliferation because human GH as well as recombinant bovine GH stimulated thymidine uptake in RAB-9 cells. A monoclonal antibody specific for the rabbit GH receptor was also used to characterize the GH receptor in RAB-9 cells. In contrast to results obtained using normal nutrient medium, GH did not stimulate thymidine uptake when RAB-9 cells were maintained in nutrient poor medium. These data indicate that RAB-9 cells will be useful for rapid and repeatable studies of the growth-promoting actions of GH. At this time, only one other cell line with these properties has been reported.

#Scholarship - Ohio State University
Fourth Award - General Motors ISEF

THE EFFECTS OF KAEMPFEROL ON THE RESPIRATION RATES OF MITOCHONDRIA

Thompson, Neal L., Canton R-V, Canton, Missouri 63435
Box 68 Canton, Missouri 63435

The purpose of this project was to compare the effects of various amounts of kaempferol on the respiration of rat liver mitochondria while oxidizing proline and succinate, and to determine whether kaempferol mimics the effects of water stress on proline and succinate oxidation in plants.

The project was begun by isolating rat liver mitochondria and placing it in a reaction vial for the measurement of O_2 consumption while oxidizing either proline of succinate.

It was found that with both proline and succinate kaempferol decreased coupling (RCR) as kaempferol concentration increased. The addition of kaempferol decreased oxygen consumption during state III and IV rates for proline. When succinate was oxidized, increases in state III occurred with the addition of kaempferol.

A possible explanation for the observed changes in coupling and oxygen consumption (state III and IV rates) can be found by looking at the electron transport chain within the inner membrane of the mitochondria. The chain is responsible for setting up a proton gradient which is needed for phosphorylation. If kaempferol were to destroy or damage this chain, then the amount of coupling would decrease. Since the mitochondria uses oxygen in the removal of the unwanted electrons produced by the formation of ATP, it would be expected that if coupling decreased so would oxygen consumption. This was found to be the case. It was also found that kaempferol mimicked water stress in plants.

HELMINTH STUDIES IN CANINES

Veronica A. Raker
Elko High School
987 College Ave.
Elko, Nevada
379 Valley Bend
Elko, Nevada 89801

Many pet owners are unsure about the frequency and treatment of helminth infections in their dogs. In my study of helminths, or parasitic worms, I concentrated on tapeworms and roundworms, which are the most common in Nevada. My project was to discover the frequency of this infection in otherwise healthy dogs and to find the length of time for a dewormed dog to become reinfected. I also wanted to find the differences in the effectiveness of an injectable dewormer and a capsule dewormer.

I analyzed fresh fecal samples from 36 dogs to find either tapeworm segments or worm eggs, which I located with a microscope. I used each dog's clinical record to find the length of time since it had been dewormed. I then chose two groups which each contained 6 infected dogs. I dewormed group A with a capsule dewormer and group B with an injectable dewormer. I made daily fecal examinations from each dog for three days.

I found that over 50% of the dogs were infected when I tested them, even though some had been dewormed only 3 weeks prior to my experiment. I also found that the injectable dewormer worked immediately while the capsule dewormer worked over a day or two. However, both dewormers had the same effectiveness over a three day period.

Pet owners should be aware that many dogs are worm-infected, and that they should deworm their dogs regularly.

#INVESTIGATING THE MYSTERIOUS HUMPBACK WHALE

Coy, Christopher C., Sir Winston Churchill, St. Catharines, ON, L2T2N1
One Ridley Road, St. Catharines, Ontario, L2S 2H3

Humpback whales, (Megaptera novaeangliae), are known for the variety of black and white markings on the ventral side of their flukes. It was found that each individual humpback has its own unique pattern of fluke color (Katona et al.) in the 1970's. Since every humpback has distinct tail markings, they can act as 'fingerprints' for identification of individuals.

By photographing and comparing flukes over a three summer period off the eastern coast of Newfoundland, some interesting trends were discovered. Of 24 positively identified individuals, none were found to have killer whale scar tissue, despite the fact that 33% of all previously photographed humpbacks do have killer whale caused scars. During the summer of 1983, 85% of all humpbacks were first-time sightings. This high percentage of new humpbacks suggests that current population estimates for western North Atlantic stocks may be too low.

In collaboration with the College of the Atlantic, the first resighting over a four year period was discovered. In 1982, humpback #1319 was photographed off Cape Bonavista. One year later the same whale was sighted just 20 miles away. Furthermore, both years the whale was travelling with a different companion.

Results such as these lend further insight into the mysteries of population size, grouping, movement, life-cycle and migration. Other aspects of this project deal with analysis of humpback vocalizations, the problem of whale entrapments, exotic humpback behaviours, dive durations and ecological relationships.

#Third Award - National Oceanic and Atmospheric Administration
Fourth Award - General Motors ISEF

ISEF PROJECT CATEGORIES

This preliminary list of Category Descriptions has been made up in response to the many requests for clarification in order to help students and teachers make category selections.

Category Descriptions:

The General Motors ISEF Grand Awards are given in twelve different categories. The categories and examples of the types of projects belonging to each are as follows:

Behavioral and Social Sciences: Psychology, sociology, anthropology, archaeology, ethology, ethnology, linguistics, animal behavior (learned or instinctive), learning, perception, urban problems, reading problems, public opinion surveys, educational testing, etc.

Biochemistry: Molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones, etc.

Botany: Agriculture, agronomy, horticulture, forestry, plant biorhythms, palynology, plant anatomy, plant taxonomy, plant physiology, plant pathology, plant genetics, hydroponics, algology, mycology, etc.

Chemistry: Physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, fuels, pesticides, metallurgy, soil chemistry, etc.

Earth and Space Sciences: Geology, geophysics, physical oceanography, meteorology, atmospheric physics, seismology, petroleum, geography, speology, mineralogy, topography, optical astronomy, radio astronomy, astrophysics, etc.

Engineering: Civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, heating and refrigerating, transportation, environmental engineering, etc. Power transmission and generation, electronics, communications, architecture, bioengineering, lasers, computers, instrumentation, hardware, firmware, and systems software design, configuration, construction and testing, etc.

Environmental Sciences: Pollution, (air, water, land), pollution sources and their control, waste disposal, impact studies, environmental alteration (heat, light, irrigation, erosion, etc.), ecology.

Mathematics and Computers: Calculus, geometry, abstract algebra, number theory, statistics, complex analysis, probability, topology, logic, operations research, and other topics in pure and applied mathematics. Computer application, software of a general quantative or algorithmic nature, etc.

Medicine and Health: Medicine, dentistry, pharmacology, veterinary medicine, pathology, ophthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, optometry, etc.

Microbiology: Bacteriology, virology, protozoology, fungal and bacterial genetics, yeast, etc.

Physics: Solid state, optics, acoustics, particle, nuclear, atomic, plasma, superconductivity, fluid and gas dynamics, thermodynamics, semiconductors, magnetism, quantum mechanics, biophysics, etc.

Zoology: Animal genetics, ornithology, ichthyology, herpetology, entomology, animal ecology, anatomy, paleontology, cellular physiology, animal biorhythms, animal husbandry, cytology, histology, animal physiology, neurophysiology, invertebrate biology, etc.

Category Interpretations:

It is impossible to develop category descriptions which can be applied to any and all projects without some questions. In particular, the increasingly interdisciplinary nature of science and engineering means that many projects will draw upon more than one field. To determine a project category, it may therefore be necessary to identify the primary emphasis.

For example, limnology is defined as the scientific study of the physical, chemical, meteorological, and biological conditions in fresh water. A project in limnology would thus have to be considered from the point of view of its primary emphasis (physics, chemistry, etc.) to be placed in the appropriate category.

Below is a list of project areas about which questions frequently arise. This is not a complete list, and is simply given to provide some basis for interpretation of the category descriptions.

Instruments:

The design and construction of a telescope, bubble chamber, laser, or other instrument would be Engineering if the design and construction were the primary purpose of the project. If a telescope were constructed, data gathered using the telescope, and an analysis presented, the project would be placed in Earth and Space Sciences.

Marine Biology:

Behavioral and Social Sciences (schooling of fish), Botany (marine algae), Zoology (sea urchins), or Environmental Sciences (plant and animal life of sea, river, pond).

Fossils:

Botany (prehistoric plants), Chemistry (chemical composition of fossil shells), Earth and Space Sciences (geological ages), and Zoology (prehistoric animals).

Rockets:

Chemistry (rocket fuels), Earth and Space Sciences (use of a rocket as a vehicle for meteorological instruments), Engineering (design of a rocket), or Physics (computing rocket trajectories). A project on the effects of rocket acceleration on mice would go in Medicine and Health.

Genetics:

Biochemistry (studies of DNA), Botany (hybridization), Microbiology, (genetics of bacteria), or Zoology (fruit flies).

Vitamins:

Biochemistry (how the body deals with vitamins), Chemistry (analysis), and Medicine and Health (effects of vitamin deficiencies).

Crystallography:

Chemistry (crystal composition), Mathematics (symmetry), and Physics (lattice structure).

Speech and Hearing:

Behavioral and Social Sciences (reading problems), Engineering (hearing aids), Medicine and Health (speech defects). Physics (sound), Zoology (structure of the ear).

Radioactivity:

Biochemistry, Botany, Medicine and Health and Zoology could all involve the use of tracers. Earth and Space Sciences or Physics could involve the measurement of radioactivity. Engineering could involve design and construction of detection instruments.

Space-related projects:

Note that many projects involving "space" do not go into Earth and Space Sciences. Botany (effects of zero G on plants), Medicine and Health (effects of G on human beings), Engineering (development of closed environmental system for space capsule).

Computers:

Computers will no longer be assigned to mathematics. Instead, if the computer is used as an instrument, the project should first be considered for assignment to the area of basic science on which the project focuses. As examples: if the computer is used to calculate rocket trajectories then it would be assigned to Physics, or if the computer is used to calculate estimates of heat generated from a specified inorganic chemical reaction then it should be entered in Chemistry, or if the computer is used as a teaching aid it should be entered in Behavioral and Social Sciences.

ALPHABETICAL LISTING OF FINALISTS

General Motors ISEF Grand Awards, or awards from one or more of the ISEF Special Awards Organizations are listed at the end of abstracts of Finalists who won awards.

Addington, D.P. - 175
Ahle, M. - 151
Ahmad, F.Z. - 185
Al-Qadi, H.A. - 221
Al-Shabknoun, A.J. - 82
Alfonso Sosa, E. - 86
Alford, R.C. - 244
Allen, J.W. - 53
Ambrosiak, J. - 83
Ames, S.L. - 161
Amsel, F. - 147
Andersen, K.L. - 266
Anderson, G.W. - 150
Anderson, H.S. - 11
Anderson, P.R. - 125
Anderson, R. - 94
Armstrong, R.M. - 58
Ashmead, S. - 62
Ashton, L.B. - 78
Ashy, C.G. - 178
Atkins, T.J. - 207
Audi, S.A. - 24
Awh, E.S. - 34
Babbitt, S.E. - 15
Bachman, B.A. - 180
Badders, D.C. - 171
Bailie, B.D. - 125
Baker, L.M. - 208
Baorto, M. - 238
Barker, T.E. - 222
Barnett, J.L. - 50
Barrentine, K.A. - 61
Barrick, S.C. - 233
Bartos, B.J. - 180
Battalora, J.M. - 36
Baughman, J.S. - 172
Beaver, R.W. - 75
Beck, D.S. - 134
Becker, R.M. - 139
Beglin, R.M. - 179
Bellian, K.T. - 193
Benzoe, W. - 155
Berg, P. - 88
Berneburg, C.J. - 229
Berrett, S.L. - 142
Bibb, K.L. - 127
Biederstedt, R.D. - 20
Bigbee, A.J. - 162
Bishop, S.D. - 88
Blake, J. - 259
Blankespoor, C.L. - 202
Blinkow, A. - 257
Boesch, M.A. - 129
Bolterman, G.J. - 210
Bonnette, K.J. - 213
Boran, C.P. - 114
Boroski, L.A. - 167
Borsoni, M. - 146
Bowman, M.P. - 91
Brady, H.R. - 76
Brandenberger, D.L. - 267
Brandstein, H.J. - 179
Bratcher, R.A. - 110
Braunels, G.W. - 155
Brock, D. - 223
Brothers, M.J. - 230
Brown, P.L. - 18
Brown III, J.A. - 167
Brundage, R.A. - 197
Buchle, T. - 187
Buesching, D.A. - 64
Bullock, C. - 101
Burger, B.T. - 93
Burgess, T.J. - 47
Butler, B.D. - 70
Cachon, G. - 158
Calakos, N. - 20
Calfee, G.W. - 94
Call, S.A. - 54
Campbell, C. - 119
Campbell, G.S. - 262
Campbell, T.M. - 144
Capp, V.K. - 145
Carlton, J.G. - 163
Caro-Padilla, A.M. - 57
Carpenter, J.A. - 151
Carrasquillo-Vazquez, N. - 58
Carrion, M. - 43
Carson, A.M. - 74
Caruthers, S.D. - 47
Catuk, T.J. - 98
Chapman, D.R. - 232
Chappell, A.G. - 256
Charrier, J.R. - 72
Charter, S.A. - 222
Cheng, P.C. - 194
Cherry, D.L. - 230
Chew, A.F.M. - 212
Chisson, J.A. - 251
Christensen, G.E. - 243
Cintron, V. - 97
Cobb, J.V.M. - 149
Coburn, C.A. - 127
Collier III, G.A. - 62
Conley, A.A. - 17
Constable, A. - 250
Cooper, J.L. - 152
Corria, L.R. - 131
Couvion, E. - 268
Cox, J. - 217
Coy, C. - 274
Craft, L. - 68
Crawford, B. - 191
Crawford, P. - 271
Crespo-Mendez, A. - 186
Crowley, K.L. - 233
Cruttenden, L.A. - 54
Cruz-Ramirez, P. - 59
Csele, M.S. - 237
Cunningham, K. - 257
Curry, T.D. - 196
Dabbert, C.B. - 264
Davenport, W.J. - 159
Davidson, B.L. - 101
Davis, A.R. - 177
Davis, C.L. - 98
Day, S. - 6
Dean, K.D. - 268
DeArman, M. - 253
Decker, G. - 187
Deem, S. - 241
De Jesus, P. - 107
de La Pena, R.D. - 124
DeLeon, R.R. - 87
del Giudice, A. - 169
Devaraj, M. - 203
Diaz-Ruiz, A. - 225
Dixon, M.G. - 180
Do, C.V. - 30
Do, T.H. - 83
Domeier, L.L. - 17
Doyle, J.K. - 254
Drake, D.M. - 113
Duer, J. - 114
Dukes, C.D. - 215
Dunn, Jr., T.D. - 46
Durbin, P.A. - 61
Dwivedy, S. - 48
Dworkin, J.E. - 5
Dwyer, D.K. - 227
Dziuk, P.M. - 115
Eda, K.E. - 158
Egly, L. - 194
Ellgaard, A.K. - 258
Elliott, Jr., L.M. - 52
Elliott, S.D. - 260
Emkey, J.M. - 182
Erb, S.C. - 90
Esser, J.D. - 170
Eward, K.L. - 178
Fabijanski, L.A. - 44
Falck, T.L. - 7
Fanelli, P. - 106
Feinerman, G.A. - 200
Feliu-Baez, J.M. - 136
Fernandez, R.A. - 21
Flynn, G.J. - 163
Folse, R.F. - 165
Ford, B. - 137
Foss, P.W. - 8
Fraley, C.L. - 156
Francisco, S.R.L. - 41
Frank, D. - 258
Fudge, G.A. - 159
Gaddy, G.D. - 198
Galarus, D.E. - 156
Gann, M.E. - 138
Gann, M.E. - 253
Garcia, J.A. - 263
Garcia-Velazquez, H.E. - 73
Gaskill, M.J. - 27
Gastreich, K.R. - 191
Gavin, J.L. - 223
Gedris, M.C. - 215
Gemmill, J.M. - 226
Germann, E.K. - 116
Gessler, D. - 171
Gessler, M. - 82
Goff, D.H. - 122
Goldstein, A. - 31
Goodell, M. - 231
Gorman, D.S. - 201
Graham, J. - 193
Graham-Goins, D.J. - 34
Gray, D.A. - 23
Green, D. - 195
Groves, L.J. - 204
Guffey, A. - 252
Guthrie, D.P. - 132
Hall, G.L. - 16
Hamilton, D.K. - 60
Hardee, J.L. - 130
Hartman, K. - 241
Hasegawa, H. - 250
Hatch, T.L. - 19
Hauser, J. - 112
Hausler, C. - 55
Hawthorne, B.A. - 104
Headrick, D.D. - 238
Heinze, K. - 25
Helbig, C. - 54
Hendel, E.L. - 55
Henderson, J.D. - 234

Henderson, J. - 24
Henderson, T.A. - 235
Henriquez-Aguilar, A.M. - 8
Heppler, H.L. - 272
Hernandez, M.A. - 175
Herring, M.A. - 247
Herrmann, S.L. - 102
Higdon, J.R. - 2
Hinkle, B. - 242
Hoang, V. - 133
Hodge, J.L. - 205
Hoggard, B.G. - 154
Hopkins, C. - 39
Horton, C.K. - 269
House, V.L. - 190
Hoyas, J.J. - 86
Hruby, J.L. - 220
Hruska, L.L. - 212
Hu, A.J. - 173
Huff, A.L. - 202
Hughes, M.R. - 242
Hughey, D.W. - 174
Humble, R. - 236
Hunokler, P.T. - 130
Hunkley, R.E. - 270
Ibrahim, K. - 10
Ingram, C.L. - 120
Ingram, M.L. - 120
Jackson, M.T. - 163
Jackson, P.S. - 35
Jameson, J.F. - 140
Jarman, T.E. - 262
Jayatilleke, H. - 108
Jenkins, T.M. - 138
Johnsen, S.L. - 148
Johnson, C.R. - 63
Johnson, J.E. - 65
Johnson, J.L. - 107
Johnson, M. - 117
Johnson, P. - 64
Johnson, S. - 247
Jones, A.H. - 121
Jones, S.A. - 152
Jones, Jr., S.R. - 99
Jones, W.R. - 239
Jonsell, M. - 263
Jordan, C.R. - 157
Juckes, L.M. - 49
Kain, S.M. - 19
Kastin, B.R. - 189
Katz, S. - 184
Keller, A.M. - 133
Kent, L.L. - 13
Kerner, J.D. - 185
Kieffer, H.J. - 135
Killeen, E. - 4
Kim, T.H.S. - 216
King, B. - 125
King, C.E. - 21
Kirkmire, C. - 9
Knepper, T.J. - 244
Knight, A. - 108
Knight, L.K. - 219
Knorr, C.M. - 140
Kothenbeutel, J.E. - 228
Kreutter, K.D. - 214
Kubes, J.S. - 70
Kudla, A.J. - 131
Kudrak, M.E. - 270
Kummet, J. - 194
Kung, A.L. - 183
Kwook, D. - 25
LaDuke, S.P. - 169
Laible, P.D. - 56
Lamadrid, V. - 45
Lamperez, A.J. - 208
Lansdale, S.L. - 145
Larson, N. - 237
Last, K.J. - 220
Lee, S. - 245
Lemley, J.E. - 209
Levine, P.J. - 142
Lindauer, K.L. - 63
Linford, M.R. - 40
Link, L.A. - 93
Lopez, L. - 87
Lowe, D.A. - 115
Lowe, J.R. - 272
Lowe, K.C. - 22
Lucca, A.E. - 57
Lund, J.R. - 111
Luong, T. - 80
Luther, K.E. - 78
Luthy, B.H. - 136
Lyman, L.M. - 15
Mackman, R.L. - 119
Mailhot, J.N. - 173
Maldonado-Alfandari, M.E. - 100
Marks, D.A. - 124
Markway, J. - 153
Martin, D.M. - 68
Mason, T.G. - 174
Matos, M.A. - 79
Mattie, M.E. - 128
Mauldin, J.A. - 170
McCoy, M.J. - 32
Melendez-Lopez, P.A. - 216
Melendez-Melendez, A. - 28
Melton, M.K. - 11
Mendez-Torres, A. - 232
Methvin, R.K. - 143
Michel, K.K. 16
Millard, A.L. - 204
Minjares, D.A. - 188
Minyard, W.P. - 259
Miranda-Albino, J.R. - 251
Moody, C. - 164
Mooney, Jr., C.R. - 176
Moore, J.C. - 228
Moore, M.A. - 3
Morell-Marrero, G. - 243
Moreno, E.M. - 141
Moritz, V.C. - 12
Munoz-Camps, J. - 69
Munshi, I.A. - 38
Murphy, Jr., D. - 28
Myers, M.T. - 248
Nelson, P. - 48
Nettles, A.M. - 226
Neumann, T.B. - 24
Nevulis, L. - 70
Newsom, B.A. - 267
Newton, C.C. - 56
Nguyen, H.T. - 36
Nielsen, B.A. - 95
Nishimoto, S. - 89
Norrie, S.R. - 31
O'Brien, C.D. - 240
O'Brien, D. - 90
Ossio, W.C. - 168
O'Connor, S. - 195
Ogburn, M.A. - 4
Ohlhausen, E.L. - 79
Olerud, M.D. - 240
Olson, D.F. - 122
Ortwerth, M. - 42
Ott, D.A. - 77
Ouellette, E.J. - 111
Owens, M.D. - 109
Oyler, E. - 106
Parker, A.L. - 221
Parker, P.K. - 253
Parvin, G.A. - 261
Patel, A.M. - 121
Pealer, D.D. - 92
Pearcy, C.A. - 181
Pennington, B.D. - 43
Peoples, R.E. - 205
Perez, D. - 152
Perez, R. - 50
Perez-Vega, F.J. - 264
Perez-Quinones, Z. - 13
Perkins, L.A. - 224
Perrigo, V. - 98
Petro, C.L. - 103
Phillips, T. - 91
Philpot, A.G. - 10
Pickle, S.J. - 261
Picou, S. - 150
Piester, R. - 28
Pilkerton, R. - 214
Pinkofsky, R.E. - 225
Plessman, P.J. - 199
Ploetz, W. - 246
Potts, K. - 9
Pratt, S.E. - 206
Preston, J.T. - 218
Pulido, S.M. - 26
Pyott, A.S. - 71
Quan, R. - 73
Rahall, G.G. - 160
Raker, V.A. - 274
Ramsey, S.C. - 137
Randall, D. - 172
Randolph, K. - 187
Rapp, D.A. - 99
Rasmussen, J.Y. - 219
Redding, R.E. - 218
Redmill, K.A. - 76
Reed, B.C. - 182
Reinertsen, K.K. - 190
Renuart, D.R. - 53
Rhees, J. - 65
Riat, D.A. - 128
Richards, D.W. - 45
Richards, W.M. - 151
Richardson, E.J. - 234
Richtsmeier, D.J. - 255
Rider, T.H. - 96
Rivera, M. - 126
Rivera-Medina, S. - 46
Rivera-Soto, L. - 265
Riza, M.S. - 104
Roberts, B.L. - 104
Robinett, C. - 2
Rodriguez, Q. - 5
Rodriguez-Madera, V.F. - 181
Rodriguez-Molina, G. - 192
Rogers, C.K. - 123
Rogers, P. - 61
Rolon-Morales, I.D. - 159
Roman-Irizarry, E.J. - 213
Rooney, Jr., J.G. - 196
Roop, T.J. - 271
Rosario, R.T. - 38
Ross, F. - 81
Rusche, K. - 249
Rusert, F.E. - 144
Sanchez, D.M. - 59
Sanchez, P.E. - 18
Sanchez-Jimenez, J.A. - 252
Sandberg, J.A. - 113
Santana, A.E. - 143
Santana, E.A. - 249
Santiago, S. - 228

Sargent, E. - 102
Scearce, K.A. - 14
Schmidt, C.E. - 153
Schnute, M.E. - 51
Schott, K.L. - 26
Schuler, R.W. - 120
Scott Jr., R.B. - 123
Self, J.L. - 141
Serra, F.G. - 255
Seymour, J.C. - 162
Shakespear, D. - 118
Shane, A.L. - 132
Shapira, N.A. - 27
Sharif, E. - 176
Sharma, P. - 71
Shealy, S. - 157
Sheets, L.J. - 75
Sheridan, P.H. - 235
Shindler, K.M. - 7
Shipley, M.E. - 77
Shively, C. - 245
Shively Jr., R.J. - 33
Siegfried, R.A. - 186
Simmes, T.N. - 266
Simon, K.D. - 229
Simon, S.G. - 207
Sivertson, E.P. - 239
Smith II, C.L. - 84
Smith, D.C. - 112
Smith, D.D. - 92
Smith, M.J. - 40
Smith, S. - 227
Smith, S.L. - 256
Smith, T.A. - 201
Smith, T.E. - 14
Sorenson, J.K. - 30
Sousa, J.M. - 209
Sparks, P.A. - 200
Spies, H.A. - 19
Spooner, T.M. - 35
Staley, K.L. - 265
Stanton, D. - 40
Stevens, L.G. - 145
Stevenson, C.J. - 109
Stewart, J.H. - 89
Stitt, S. - 85
Stockwell, T.D. - 105
Stoll, K.E. - 183
Stone, K.A. - 206
Strykowski, P.J. - 166
Stults, M.D. - 129
Swallow, J.R. - 165
Swami, J.K. - 96
Swarthout, B.L. - 3
Swenson, M.M. - 198
Tamayo, R.E. - 49
Tanner, M. - 72
Tennison, J.T. - 67
Than, D. - 29
Tharaseparambil, A.D. - 116
Thomas, C.L. - 114
Thomas, L.S. - 146
Thompson, M. - 139
Thompson, N.L. - 273
Thompson, S. - 1
Thrailkill, T.A. - 211
Tokuno, H.A. - 33
Tolbert, M.B. - 84
Tomashek, J.J. - 262
Top, S.K. - 41
Topolovac, M. - 105
Torgerson, T.R. - 85
Torres, D. - 168
Torres, F. - 42
Torres, J.A. - 60
Torres, W.I. - 199
Townsend, H.B. - 188
Tseng, A.A. - 23
Tully, R.D. - 37
Turnipseed, J.P. - 126
Tyler, T.N. - 32
Uharriet, J. - 217
Uppal, B. - 154
Urdani, M.K. - 203
Van Beek, S.D. - 210
Van Bladel, K.N. - 44
Vance, T. - 211
Vega-Huntalvo, J.V. - 260
Vera-Munis, C.J. - 47
Vu, L.N. - 66
Walker, K.B. - 148
Walz, K.J. - 177
Wang, C. - 51
Ware, B. - 100
Warren, M.S. - 110
Wayne, D.E. - 9
Wehling, A. - 192
Weinbaum, A.E. - 6
Weiss, D.L.P. - 1
Welch, S.D. - 161
Welker, R.M. - 64
Wentworth, E.C. - 135
Werner, M. - 246
Wheeler, B.A. - 82
White, R.S. - 254
Wilcox, R.J. - 149
Wilcox Jr., W.E. - 236
Wilkinson, C.A. - 184
Wilkinson, L.S. - 12
Williams, M.D. - 273
Williams, T. - 81
Wilmeth, R. - 240
Wiltshire, D. - 248
Wolfe, E.A. - 118
Wolfe, S.F. - 67
Wood, M.C. - 66
Woodring, D.W. - 52
Woodson, C.H. - 269
Woodward, M. - 147
Woodward, L.R. - 69
Worrel, B.M. - 160
Wray III, R.E. - 37
Wright, G.L. - 189
Wright, W.M. - 134
Wydoski, S.G. - 11
Wu, S.L. - 29
Wu, T.T. - 231
Yakeson, B. - 22
Yanish, K.J. - 197
Yeager, I.G. - 103
Yegerlehner, J.D. - 164
Yim, C.Y. - 80
Young, C.A. - 233
Young, E.A. - 33
Yu, J. - 166
Zand, D.J. - 39
Zielke, D.M. - 117
Zigan, M.J. - 95
Zoltewicz, S. - 74
Zorrilla, J.J. - 97

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